INTRODUCTION

Cataract is the leading cause of avoidable blindness in India and is responsible for up to 50-80 percent cases of bilateral blindness[1]. The significant backlog of individuals who are blind due to cataract, waiting for surgery, has resulted in cataract being the leading cause of avoidable blindness globally, including in India.

The reasons for this backlog include lack of access to eye care and lack of resources, specially trained surgeons, to deliver cataract surgery safely, and reliably[2]. Two most common techniques used nowadays for cataract extraction are small incision cataract surgery (SICS) and phacoemulsification.

Phacoemulsification is the surgery of choice in developed countries whereas Small Incision Cataract Surgery is the most commonly done cataract surgery in charitable hospitals in developing countries, like India. The reason for this is high costs involved in setting up and doing a Phacoemulsification surgery which requires a Phacoemulsifier machine compared to Small Incision Cataract Surgery which is manual and is therefore much economical[3].

The advantage of both techniques are that they are suture-less, require small incisions, and result in faster visual rehabilitation.[3]

Surprises in refractive errors after cataract surgery have become unacceptable in recent few years. As a result, cataract surgery has become refractive surgery offering improvements both in “best corrected” and “uncorrected” visual acuity. One aspect which has confounded the cataract surgeons is the postoperative induced astigmatism. Surgically induced astigmatism (SIA) calculates the magnitude and axis of postoperative induced astigmatism.

Postoperative astigmatism is affected by various factors such as preoperative astigmatism, location, type, size, closure, and healing of the surgical incision, amount of scleral cauterization performed, type of suturing material used and its placement, position of IOL, and postoperative use of steroids, and all these have effects on corneal curvature.

Control of surgically induced astigmatism has become a clinical efficacy benchmark when evaluating cataract surgical outcomes. Astigmatism is influenced mainly by size and site of incision.

In phacoemulsification the incision size is smaller than SICS therefore the astigmatism induced is lower.

Various studies give conflicting reports regarding the amount of astigmatism induced and the post-operative visual outcome of phacoemulsification and small incision cataract surgery.[2,3] Therefore it is important to find the effective method of cataract surgery (phacoemulsification or manual small incision cataract surgery) which induces the least or no astigmatism post surgically and gives better visual outcome.

This study will compare the surgically induced astigmatism and post-operative visual acuity of two groups of patients who have undergone phacoemulsification and small incision cataract surgery.

AIM OF THE STUDY

1. To compare the surgically induced astigmatism in Small Incision Cataract Surgery (SICS) and Phacoemulsification.
2. To compare the Post-Operative Uncorrected and Best Corrected Visual acuity in SICS and Phacoemulsification.

REVIEW OF LITERATURE

History and Evolution of Cataract Surgery

The history of cataract surgery starts from more than 20 centuries ago. In its earliest form, couching was used as a primary method to treat cataracts by dislodging the cataractous lens away from pupillary area.[4] The written description of couching was first given by Indian surgeon Sushruta (600 BC). He used two instruments – a sharp lancet to penetrate the sclera around 4mm temporal to limbus and a blunt needle passed through the conjunctiva behind the iris to dislodge the lens. The temporal approach was used as couching was performed in sitting posture and surgeon facing the patient.[5]

Jacques Daviel, the father of modern cataract surgery, introduced the incisional extraction of the cataract in 1753. He described a planned extracapsular cataract extraction and he placed the incision in inferior limbus as patient was operated in seated position.[6]

Surgeons like Albert Von Grafe (1867), Christiane (1845), A. Terson (1871) and G. Reuling, contributed to the popularity of Intra-Capsular cataract extraction, as it was considered safer.

Harold Ridley introduced artificial lens IOL implantation in 1949.[7] Modern PCIOL was devised by S.P. Shearing with J loops. Introduction of intra ocular lens implantation led to an end to the era of ICCE. The need for safe scaffolding for IOL shifted the focus towards extracapsular cataract extraction (ECCE). The other additional influencing factors were the quest for smaller incision and lesser post-operative complications.

William Simcoe introduced the 23-gauge irrigating cannula with suction by syringe for ECCE. He popularized the 'grasp' method of nucleus delivery.

The introduction of the anterior chamber maintaining viscoelastic gel, hyaluronic acid, contributed to safer and more highly successful surgeries.

Charles Kelman (1967) introduced Phacoemulsification of the cataract through a small wound,[8] but initially the procedure failed to catch on due to high rate of complications like corneal edema, vitreous loss and technical difficulties. The resurgence of phacoemulsification was due to development of various nucleus manipulation techniques and the foldable implants.

In 1983, Gerald t. Keener JR, invented a new form of cataract surgery which combined the advantages of a standard Phacoemulsification with those of a conventional extra capsular cataract extraction (ECCE). He called it Small Incision Cataract Surgery (SICS).[9]

PHACOEMULSIFICATION

Phacoemulsification was introduced by Kelman in 1967.[10] Phaco machines consist of two main parts, a computer (console) to generate and regulate electrical signals and a transducer which turns these electronic signals into mechanical energy.

PHACOEMULSIFICATION MACHINE: [10, 11]

The machine consists of the console, foot pedal, hand piece and their connections.

CONSOLE: The console is a computer which controls all the functions of the machine. The setting for the various parameters, i.e. power, vacuum and flow rate are controlled from here.

HANDPIECE: There are two types of hand pieces—phaco hand piece and irrigation aspiration hand piece.

The phaco hand piece contains the piezoelectric crystals, which is in contact with the tip. Ultrasonic power is produced by enclosed piezoelectric crystals which convert electricity into mechanical vibration.

FIG. 1: PHACOEMULSIFICATION MACHINE

The mechanism of emulsification is a combination of the bombarding action of the tip (Jack-hammer) and cavitation phenomenon caused by the high velocity of the tip moving backwards.

PHACO TIPS: These are made up to titanium. It can have an opening angulation of 0°, 15°, 30°, and 45°. Greater angulation facilitates sculpting whereas lower angle is good for occlusion. The tip is covered with silicon sleeve that insulates and protects the tissue at the incision site to prevent corneal burns.

FOOT PEDAL OR FOOT SWITCH: The foot pedal is used to control irrigation, aspiration and phaco power. It can also contain various other functions depending on the type and make of machine.

STEPS OF PHACOEMULSIFICATION SURGERY

INCISION AND WOUND CONSTRUCTION

Ideal incision for phacoemulsification should be astigmatically neutral and free from sutures.

- Sclerocorneal: Surgically induced astigmatism reduces when one moves away from the cornea. A large incision (5.5 mm) can be made at this site without inducing much astigmatism.
- Limbal incision: This is made 0.5mm posterior of limbal vascular arcade,that is on fixed conjunctiva.
- Clear corneal incision: The incision is made 0.5mm anterior to limbus, i.e., anterior to limbal vascular arcade.

CAPSULORHEXIS

Continuous curvilinear capsulorhexis (CCC): It was developed independently in the mid-80s by Gimbel and Neuhann. Capsulorhexis can be performed with bent 26 or 27 G needle or capsulorhexis forces (Utrata's forceps).

NUCLEUS MANAGEMENT [12]

There are different methods of nucleus management in Phacoemulsification:

- DIVIDE AND CONQUER: 4 basic steps are involved.
    1. Sculpting until a very thin posterior plate of nucleus, if any remains.
    2. Fracturing the nuclear rim and posterior plate of the nucleus and nuclear rim.
    3. Fracturing again and breaking away a wedge shaped section of nuclear material for emulsification.

4. Rotating the nucleus for further fracturing and emulsification.

- CRATER DIVIDE AND CONQUER: Initially, deep central sculpting is done, resulting in a large crater, and leaving a dense peripheral rim to fracture into multiple sections. Once this is complete, the nuclear rim is fractured, using the bimanual method in which the spatula/chopper and the phacoemulsification tip create a counter pressure. The lens is rotated and a second crack is made, isolating a pie-shaped section. The nuclear rim is then rotated clockwise, for systematic piece-by-piece nucleo-fracture. The harder the nuclear rim, the smaller the wedge-shaped sections must be, to allow manageability and to reduce the possibility of tearing the posterior capsule.
- TRENCH DIVIDE AND CONQUER (TDC): A central trench a central fracture is created, and then the left as well as right sides of the lens are divided by fracturing.
- FOUR QUADRANTS DIVIDE AND CONQUER: This is preferably done using 30° or 45° needle.
- PHACO CHOP: K. Nagahara introduced the phaco chop in 1993. A chopping instrument (the hatchet) is used to split the nucleus (the log) resting against the phacoemulsification tip (the chopping block). This permits the nucleus to be fractured along its longitudinal fibers using appositional forces rather than the parallel forces used by Gimbel.
- STOP AND CHOP: Koch and Katzen, modified the phaco-chop technique to provide space for tissue separation, nucleus manipulation, and aid ease of removal. A crater or a trench is made first and then one stops and then chopping is performed.

ASPIRATION AND IRRIGATION

This is done for removal of remnant nuclear fragments and cortical matter from anterior chamber, posterior chamber and capsular bag, after emulsification and removal of nucleus.

INTRAOCULAR LENS IMPLANTATION

The most common IOLs used for phaco surgery are foldable IOLs. The rigid IOLs can also be used in phaco surgery but a suture is required to close the wound. Foldable IOLs are implanted using an injector or using forceps. The folding techniques are based on horizontal principle which allows a one-step implantation or a vertical principle which requires a 2 step implantation.

SMALL INCISION CATARACT SURGERY

Small incision cataract surgery (SICS) is the most commonly used surgery technique for cataract extraction in developing countries. The visual outcome achieved is good and the cost involved is much lesser than conventional phacoemulsification surgery.[13, 14]

STEPS OF SICS

INCISION [15]

There are three steps to making an SICS incision. They are as follows:

1. Scleral groove (external incision): Following shapes of external incisions are used in SICS.
   A. Straight: Scratch incision is made at 12'O clock position 1.5 mm away and parallel to the limbus, 5.5-6.5 mm in length.

B. Frown shaped: A parabolic groove convex towards limbus is made 1.5-2mm behind limbus centered at 12'O Clock.

C. Chevron V Shaped incision: It is based on the same principle as the Frown incision. The incision is made in the form of the inverted letter 'V'. The apex of the V will is near the limbus and the base away from it.

D. The straight incision usually induces maximum astigmatism while the frown shaped and Chevron V shape incisions induce lower astigmatism.

2. Sclero-corneal pocket tunneling:

The Sclero-corneal pocket tunnel has a smaller external incision, a large internal incision and large side pocket dissection.

The groove is engaged by crescent edge and forward movement is made with gentle movements of the edge. The blade is lifted up upon reaching the limbus and moved forward along the corneal dome for uniform dissection. Up to 2 mm of clear cornea is dissected. Side pockets are made by sliding the crescents to sides.

3. Entry into the Anterior Chamber (Making the internal incision)

2.8mm or 3.2 mm angled keratome is the suitable instrument for the creation of internal incision. The keratome is inserted inside the sclera-corneal tunnel and the cornea is pierced using the tip.

<u>CAPSULAR OPENING</u>

There are 3 types of capsular openings:

1. Continuous circular capsulorhexis.

2. Envelope method

3. Can-opener-capsulorhexis

- Continuous curvilinear capsulorhexis- It is the ideal and preferred type of capsulotomy. It was described by Neuhann (Germany) and Gimbell (Canada).[16]A bent 26G needle/cystitome is used to make a capsulorhexis through either main tunnel or side port entry. The capsular flap is raised using the cystitome. Then using the cystitome, the flap is rotated either clockwise or anticlockwise. Using the shearing force a rhexis of desired size is achieved. The desired diameter is about 6 mm in most cases.[17]
- Can-opener capsulotomy technique- It is done with a 26G needle. Approximately 15-20 punctures are made in each quadrant.
- Envelope capsulotomy- In cases of morgagian hyper mature cataract an envelope technique is used.
- Pulsed Electron Avalanche Knife[18] - (PEAK-fc): Cold capsulotomy is done using this electrosurgical device.
- Fugo blade/plasma blade[19] – Has been approved for Anterior Capsulotomy by FDA.

HYDROPROCEDURES

Hydro procedures comprise of hydro dissection and hydro delineation. Cortex, nucleus and epinucleus are separated from capsule and the lens lamella is separated from cortex.

- Hydro dissection- The fluid is injected between anterior capsule and cortex. Thus separating the cortex from the lens capsule.
- Hydro delineation- The fluid is injected between the epinucleus and nucleus result in a debulking of nucleus.

NUCLEUS DELIVERY

The prolapsed nucleus in the anterior chamber can be extracted through the tunnel by the following methods-

1. Irrigating Vectis method- Irrigating Vectis is a 5mm wide Vectis, with one to three 0.3mm forward irrigating ports with a gentle superior concavity. A combination of mechanical and hydrostatic forces are used to express out the nucleus.
2. Phacosandwich technique[20] -The Vectis solid or irrigating is introduced underneath the nucleus and Sinskey's hook on the top of the nucleus; sandwiching it, the nucleus is extracted.
3. Phacofracture technique: Various phacofracture techniques are used:
    - Bisector technique-A solid curved Vectis is placed under the nucleus after injecting viscoelastic. The bisector cleaves its way through the nuclear substance.
    - Dong's technique[21] employs a nuclear hook and cleaving forceps.
    - Nuclear trisector technique- It is done by sectioning the nucleus in the anterior chamber into three pieces with the help of solid Vectis which acts like a cutting board and a trisector.
    - Phaco-salute and fracture.
    - Phaco-fracture with a wire loop.
    - Phacofracture at the exit of the tunnel- irrigating Vectis is used to deliver the nucleus and in the process it is fractured at the exit of the tunnel.

4. Blue-menthal technique- An anterior chamber maintainer system is used, constantly maintaining a positive intraocular pressure. The force of this fluid is responsible for the extrusion of the nucleus.
5. Micro Vectis technique-Micro Vectis of size 3 to 4mm in size is introduced under the nucleus following which the nucleus is expressed by applying forward pressure gently.[22]
6. Modified fishhook technique[23] - A 27G needle is bent like a hook 2mm proximal to the bevel edge; needle is again bent at right angle to the initial bend and the nucleus is prolapsed to the anterior chamber and is delivered out through the tunnel
7. Viscoexpression technique-After nucleus delivery, epinucleus is removed; a thorough cortical cleanup is done.

IOL IMPLANTATION

Viscoelastic is filled in the anterior chamber. The IOL is help using IOL holding forceps. The lower haptic and optic are guided into the bag and trailing haptic is dialed in using Sinskey's hook or 'y' shaped dialer.

ASTIGMATISM

It is the type of refractive anomaly in which no point of focus is formed owing to unequal refraction of incident light by dioptric system of eye in different meridians, but form focal lines.

CLINICAL SYMPTOMS OF ASTIGMATISM

1. Eye Strain, caused due to accommodative stress, seen in Hypermetropic astigmatism and mixed astigmatism. Small errors, which do not cause

discomfort can be accepted as physiological and may not require treatment. But in other cases all the symptoms of eyestrain may be present.

2. Headache: It can vary from mild headache to violent explosions of pain, dizziness and irritability.

TYPES OF ASTIGMATISM

I. Regular Astigmatism:

The refractive power of eye, instead of being equal in all meridians, changes gradually from one meridian to the other by uniform increments and each meridian generally has a uniform type of curve. As a rule the major and minor meridians are at right angles.

In about 90% of cases where in vertical curvature is greater than horizontal curvature, it is termed With the Rule (WTR) astigmatism. When horizontal curvature is greater than vertical curvature, it is called as Against the Rule (ATR) astigmatism. Oblique astigmatism: It is a type of regular astigmatism where the two principal meridian are not horizontal or vertical though they are at right angles to one another.

Regular astigmatism can be classified as:

A. Simple Astigmatism:

One of the focal lines falls upon the retina when the eye is at rest, while the other focal line either falls in front or behind the retina. Thus while one meridian is emmetropic, the other is either myopic or Hypermetropic. These are respectively designated as simple Myopic and simple Hypermetropic astigmatism.

B. Compound Astigmatism:

The focal lines are all either in front or behind the retina. The state of refraction is then entirely Hypermetropic or entirely Myopic. When the lines all form in front of retina, it is called as Compound Hypermetropic Astigmatism and when they all form behind the retina, it is called as Compound Myopic Astigmatism.

C. Mixed Astigmatism:

Here, focal lines are formed both in front and behind the retina. Thus, the eye becomes hypermetropic in one meridian while myopic in another.

II. Irregular Astigmatism:

When the cornea surface becomes irregular, no geometrical figure can explain the focal lines formed, is called irregular astigmatism, as in cases of corneal diseases or Nuclear Sclerosis. Such a defect cannot be compensated by spectacle correction. The irregular astigmatism caused due to irregularities of cornea can be corrected by using contact lenses.

ASTIGMATISM AFTER CATARACT SURGERY

The amount of residual astigmatic error after cataract surgery is dependent on two factors:–

1) The pre-existing astigmatism,

2) The surgically induced astigmatism.

For best post-operative visual outcome the surgically induced astigmatism should be minimal, and if possible favorable, to counteract the preexisting astigmatism.

SURGICALLY INDUCED ASTIGMATISM

The change in astigmatism that follows any ocular surgery is known as surgically induced astigmatism (SIA). Change in corneal curvature is a well-documented finding after cataract surgery and this induces a change in astigmatism which reflects the SIA. SIA is one of the major obstacles in achieving good visual rehabilitation as it necessitates spectacle wear for clear distance as well as near vision which is not desirable by most of the patients in view of the cost as well as the inconvenience.

Total post-operative astigmatism has two factors, preexisting and induced astigmatism. Total pre-existing astigmatism of the eye has a corneal and a lenticular component.[24] In pseudophakic eyes, the lenticular component is not significant and corneal component is responsible for most of the residual astigmatism. It can be measured by standard keratometry or corneal topography. The surgically induced astigmatism can be easily calculated based on the change in keratometry reading after surgery.

Calculation of surgically induced astigmatism

Vector or polar analysis are used to calculate the SIA.[25, 26] Using standard keratometry as a sole guide to astigmatism planning can be at times misleading because it fails to identify any irregular astigmatism which can limit optimum surgical results. In such cases corneal topography would be the preferable.[27]

Refractive data are usually consists of sphere, cylinder, and axis. A single reading of refraction, is not suitable for statistical analysis. The spherical component can be analyzed without difficulty but the problem resides with the cylindrical component. The cylinder is expressed in diopters and a direction is reported in

degrees. For statistical analysis of such directional data these values must be converted to vectors or as polar values.[25 28]

- Vector analysis – In this method the cylinder is considered as a vector (magnitude and direction). The vectors are compared after converting the refractive error into vectors. Thus sphere, cylinder and axis are converted into vectos.[26]
- Polar analysis - The refractive data is converted to polar values which characterizes regular astigmatism completely.[28]
- Online calculators – Two popular online SIA calculators are available at Dr. Hill's SIA Calculator and SIA Calculator (Insight Eye Clinic, New Delhi, India). They use the method of SIA calculation described by Holladay et al.[26]

Factors affecting surgically induced astigmatism

Factors affecting SIA include the

- Size of the incision [29]
- Site of the incision [30]
- Configuration of the incision [30]
- Preexisting astigmatism [31]
- Placement of sutures.

Each of these factors play an important role in determining the final post-operative residual astigmatism.

- Prajna NV et al. in 1998 [32] evaluated the safety and efficacy of ECCE with PCIOL in comparison to ICCE with aphakic glasses. They concluded that both operative procedures are safe and effective for cataract patients, ECCE with PCIOL is superior to ICCE with aphakic glasses in terms of visual acuity restoration.

- Oshika T et al. in 1998 [33] did a prospective multicenteric study for analyzing astigmatic keratotomy in eyes after cataract surgery. They showed that optical zone size, number of incisions, and incision length had significant correlations with the amount of astigmatic correction hence concluded that Astigmatic keratotomy in pseudophakic eyes is less predictable than that in eyes with idiopathic astigmatism, but the procedure is sufficiently effective in reducing the residual astigmatism after cataract surgery.
- P M Gogate et al. in 2003 [34] compared the safety and effectiveness of SICS with ECCE. They concluded that both SICS and ECCE are safe and effective techniques for treatment of cataract patients and that both techniques require similar instruments but SICS gives better results.
- Ruit S et al. in 2007 [35] did a prospective randomized control trial to compare the efficacy and visual result of phacoemulsification vs manual small incision cataract surgery in Nepal and concluded that both phacoemulsification and SICS achieved excellent visual outcome with low complication rates, however SICS was relatively faster and less technology dependent as compared to phacoemulsification.
- B.Reddy et al. in 2007 [36] compared the astigmatism induced by a superior and temporal incision in manual SICS, and astigmatism induced by clear corneal incision versus scleral tunnel in phacoemulsification surgery and concluded that significant against the rule shift in astigmatism occured in both phacoemulsification group and the manual SICS superior incision group. The manual SICS group with temporal incision had with-the-rule shift in astigmatism.

- Singh SK et al. in 2009 [37] did a randomized control trial involving 93 patients for phacoemulsification and 89 patients for SICS & concluded that there was no significant difference in visual outcome of both the surgeries.
- Venkatesh R et al. in 2010 [38] compared the safety and efficacy of phacoemulsification and manual small incision cataract surgery in white cataracts in India concluded that Manual SICS is less technology dependent faster and less expensive than phacoemulsification so it may be more appropriate to treat cataract in a developing country for matured cataracts.
- Visser N et al. in 2011 [39] evaluated visual outcomes after toric IOL implantation in patients with cataract and corneal astigmatism. They concluded that Toric IOL provided good visual outcomes for both distance and near and acceptable intermediate visual outcomes.
- Jongsareejit A et al.in 2012 [40] Compared the cost-effectiveness of the manual small incision cataract surgery and phacoemulsification, & concluded that the MSICS is more cost-effective than phacoemulsification.
- Colin cook et al. in 2012 [41] compared the results of phacoemulsification to the small incision cataract surgery in Africa. They concluded that there was no difference in intra ocular complications in two procedures, however uncorrected visual acuity and best corrected visual acuity was seen better in phacoemulsification group after 8 weeks, and also post-operative astigmatism was lesser in phacoemulsification than small incision cataract surgery.
- Malik VK et al. in 2012 [42] compared surgically induced astigmatism between superior and temporal incisions in SICS and concluded that temporal incision in SICS induces lesser SIA and hence the refraction is more stable.

- Zhang J Y et al. in 2013 [43] studied the outcome of phacoemulsification with manual small incision cataract surgery. It was concluded that there was no difference in best corrected visual acuity and intraoperative and post-operative complications of SICS and Phacoemulsification but group undergoing phacoemulsification had better uncorrected visual acuity and induced lesser surgically induced astigmatism.
- Saber H. El-Sayed et al. in 2013 [44] did the study to compare the post-operative astigmatism between suture less scleral tunnel manual small incision cataract surgery (MSICS) and phacoemulsification and concluded that both phacoemulsification and MSICS achieved excellent visual outcomes with low complication rates. MSICS, being less technology dependent, is less expensive and therefore more appropriate for treatment cataracts in the developing world.
- Ankur gupta et al. in 2014 [45] studied the surgically induced astigmatism in phacoemulsification done by 2.80 and 5.30 mm clear corneal incision and SICS done by superiorly placed 6.00 mm scleral incision concluded that phacoemulsification 2.80mm clear corneal incision surgery induces least SIA postoperatively and 6.00 mm scleral incision manual SICS induces maximum SIA.
- Shimna Iqbal et al. in 2015 [46] did a prospective comparative study on 130 eyes undergoing SICS and phacoemulsification and concluded that Phacoemulsification was superior to SICS with lower rates of surgically induced astigmatism, fewer postoperative complications and faster visual rehabilitation.
- Parikshit Gogate et al. in 2015 [47] did a meta-analysis comparing the safety, efficacy, and costs related to phacoemulsification versus SICS, and they concluded that BCVA, Endothelial cell loss and intraoperative and postoperative

complications were similar between procedures. The surgically induced astigmatism in SICS was more than phacoemulsification and final uncorrected visual acuity of most of the patients in SICS group was <6/9.

- SE. Semanyenzi et al. in 2015 [48] did a retrospective study on 644 eyes operated with phacoemulsification and SICS to determine the visual outcome and complication related to small incision cataract surgery and phacoemulsification concluded that both SICS and phacoemulsification had similar visual outcome postoperatively, however phacoemulsification provided better UCVA at 3 months after surgery.
- Jyoti Jaggernath et al. in 2015 [49] compared the safety, efficacy and cost-effectiveness of SICS and phacoemulsification for cataract surgery by studying various manuscripts and concluded that small-incision cataract surgery is comparable to phaco in almost all aspects except SICS induces more postoperative astigmatism.
- Ye Z et al. in 2015 [50] did a systematic review of manual small incision cataract surgery (MSICS) and phacoemulsification (PHACO) on the postoperative visual quality and surgical complications. They concluded that clinical efficacy and complications of MSICS was similar to that of PHACO as UCVA 1 week after surgery, post-operative capsular rupture, and corneal edema between MSICS and PHACO showed no statistical difference.
- Amitava AK et al. [51] in 2015 compared the cost effectiveness of phacoemulsification versus manual small-incision cataract surgery. They concluded that in both techniques, the post-operative visual acuity was comparable. However, with significantly lower costs, SICS was more cost

effective, with superior cost utility value. SICS was also significantly quicker than Phacoemulsification.

- Venkatesh R et al. [52] in 2016 raised awareness about the cost effectiveness and carbon footprint of manual small-incision cataract surgery (MSICS), and phacoemulsification. They concluded that due to lower postoperative induced astigmatism, phacoemulsifcation is preferable to MSICS if high visual function is required.
- Yi-Bo Yu et al. in 2016 [53] compared the clinical and optical outcomes of phacoemulsification in three incision sizes: 1.8, 2.0 and 3.0 mm and concluded that SIA was reduced by moving from a 3.0 mm incision to a 2.0 mm incision, but moving from a 2.0 mm incision to an even smaller 1.8 mm incision offered limited benefit in reducing SIA and improving visual acuity.
- Bhojak Ashish et al. [54] in 2017 study to evaluate corneal topographical changes in corneal curvature following phacoemulsification (PHACO) and following small incision cataract surgery (SICS), to compare mean corneal astigmatism following different site and size of incision, and to estimate induced astigmatism and its association with refraction concluded that PHACO wound was relatively stable right from beginning and initial induced astigmatism was relatively low. The post-operative study of mean astigmatism showed that, in both the groups there was a trend of decreasing astigmatism over a period of time but the decrease is more in PHACO as compare to SICS.
- Reshma Ramakrishnan et al. [55] in 2017 did a study aiming at Comparison of corneal changes between SICS and phacoemulsification and concluded that Surgically induced astigmatism was a significantly higher in SICS, the cause being longer length of incision in SICS, and that both the phacoemulsification and

the small-incision techniques are safe & effective for visual rehabilitation of cataract patients, although phacoemulsification gives better uncorrected visual acuity in a larger proportion of patients at 6 months.

- V Ramalakshmi et al.[56] in 2017 did a study comparing the safety, and effectiveness of phacoemulsification and small incision cataract surgery, and concluded that postoperative visual acuity of both groups was comparable. Mean surgically induced astigmatism was found to be slightly higher in small incision cataract surgery than in phacoemulsification.

Multiple studies fail to provide a unanimous answer with regards to magnitude of astigmatism induced as well as the post-operative visual status of the patients when comparing the two surgical techniques of PHACO and SICS. With this background, we decided to compare the superior scleral section SICS and superior limbal section Phacoemulsification.

MATERIALS AND METHODS

The patients in this study were divided into two groups. One group underwent Phacoemulsification and the other group underwent SICS. All the surgeries were performed by the same surgeon.

STUDY SITE:

KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi.

STUDY POPULATION:

Patients with age related cataract attending ophthalmology out-patient department of the hospital.

STUDY DESIGN:

A one year Randomized Controlled Trial.

STUDY PERIOD:

One year – 1st January 2017 to 31st December 2017.

SAMPLE SIZE:

It was calculated according to the following formula

$n = 2 (Z_\alpha + Z_\beta)^2 SD^2 / (x_1 - x_2)^2$

Where n = sample size for each group.

$Z \alpha = 1.96$, when alpha error =5 %

Z β =1.28, when power of study = 90%

Standard Deviation (SD) = 1.2 D

x_1 = mean SIA in SICS at 4 weeks = 2 D.

x_2 =mean SIA in phacoemulsification at 4 weeks = 0.7 D

$x_1 – x_2$ = effect size = 1.3

Therefore, n = 17.88

Since minimum sample size for each group is 30, so for each group 30 was taken as sample size. Thus a total of 60 patients were selected.

RANDOMIZATION:

The study subjects were randomized into two groups using simple random sampling method. 30 patients were selected in each group. The two groups were Phacoemulsification and SICS.

INCLUSION CRITERIA

Patients between 45-80 years of age, controlled for diabetes and hypertension and without any cardiovascular disease with visually significant cataract.

EXCLUSION CRITERIA

1. Cataract with retinal pathology like macular lesions, diabetic and vascular retinopathy etc.
2. Cataract with Pseudo exfoliation syndrome.
3. Cataract with advanced glaucomatous cupping
4. Complicated cataract
5. Subluxated / Dislocated cataract
6. Paediatric cataract
7. Traumatic cataract
8. Cataract with Corneal opacity
9. Posterior polar cataract
10. Cataract with Rigid pupil
11. Patients with oblique or irregular pre-operative astigmatism.
12. Cataract with corneal Astigmatism > 4D
13. Cataract with Keratoconus
14. Any patient who had undergone previous ocular surgery (trabeculectomy, refractive or retinal detachment surgery)
15. Patients who develop significant post-operative complications.

METHODOLOGY

Patients who satisfy the above criteria were enrolled in the study as subjects. A written and informed consent of the patients was taken.

Data regarding the demographic characteristics such as name, age, sex, etc. was entered onto a pre-designed proforma. The patients were randomly selected into the two groups according to the procedure they were about to undergo, Group A - Phacoemulsification and Group B- Small incision cataract surgery.

HISTORY TAKING:

- Diminution of vision
- Duration of symptoms
- Onset (Gradual/Sudden)
- Progressive / Static
- Vision affected(Distant/Near)
- Presence / absence of pain
- Coloured haloes
- Photophobia
- Flashes of light
- Diplopia / polyopia

- Floaters
- Watering
- Redness
- Discharge
- Black spots in front of the eye
- Curtain falling in front of the eyes
- Systemic conditions like Diabetes Mellitus, Hypertension.

OCULAR EXAMINATION

- Measuring the visual acuity by using Snellen's visual acuity chart.
- Slit lamp examination of the ocular adnexa, conjunctiva, sclera, cornea, pupil and lens.

FIG. 2: SLIT LAMP EXAMINATION

- Refraction to find out best corrected visual acuity.
- Keratometry was done using Bausch and Lomb keratometer.

FIG. 3: BAUSCH & LOMB KERATOMETER

- A-Scan biometry by contact method using SRK-II formula.
- IOP was measured using Schiotz tonometer or Non-Contact Tonometer.
- The cataract was graded (as per LOCS III classification) into
    - Cortical Cataract (C1 to C5)
    - Nuclear Opalescence (NC1 to NC6)
    - Posterior Sub-capsular Cataract(P1 to P5)
- Direct and Indirect Ophthalmoscopy was done to rule out any retinal pathology.
- The patency of Naso-Lacrimal duct was assessed by doing lacrimal syringing test.
- Lab investigations included Blood Pressure and Random Blood Sugar (RBS).

PRE-OPERATIVE PREPARATION:

Antibiotic drops were be instilled in the patient's eyes, hourly, a day prior to the surgery. On the day of surgery, the pupil was be dilated with topical tropicamide 0.8% and phenylephrine 5% eye drops. Peribulbar anaesthesia was administered to all patients approximately 15 minutes before surgery.

The patients underwent superior limbal 3.2 mm Phacoemulsification or 6mm superior scleral Manual SICS.

PHACOEMULSIFICATION:

For phacoemulsification, a superior 3.2mm limbal incision was made. Separate clear corneal stab incisions at 2 o'clock and 10 o'clock were made.

Hydroxy propyl methylcellulose visco-elastic was be injected into the anterior chamber. A trypan blue–assisted continuous curvilinear capsulorhexis was done using a cystitome. Hydrodelineation was just below the anterior capsule rim.

Divide and Conquer technique of phacoemulsification was performed with appropriate machine parameters according to nuclear density. The remaining cortex was removed with the irrigation / aspiration tip.

The anterior chamber was filled with visco-elastic after which a 6.0 mm optic foldable hydrophilic intraocular lens (IOL) was implanted in the capsular bag using injector.

Viscoelastic was aspirated and anterior chamber was formed using balanced salt solution. Hydrosealing of the incisions was done. Eye was padded and patched.

SMALL INCISION CATARACT SURGERY:

It was performed using a 6 mm superior frown-shaped sclerocorneal tunnel, using a crescent blade and 3.2 mm keratome.

Trypan blue–assisted capsulorhexis was created under hydroxyl propyl methylcellulose viscoelastic cover.

Hydrodissection was done, after which the nucleus was rotated and prolapsed from the capsular bag into the anterior chamber using Sinskey hook.

The nucleus delivery was done using sandwich technique.

Thorough cortical wash was given using a Simcoe's two way irrigation aspiration cannula.

The anterior chamber was filled with viscoelastic.

A Single-piece rigid poly-methyl methacrylate IOL with a 6.0 mm optic was inserted and dialled into the capsular bag.

Viscoelastic was thoroughly aspirated and anterior chamber was formed using balanced salt solution.

Hydrosealing of incision site was done.

At the end of the surgery a subconjunctival injection of 0.5ml of gentamycin (40mg/ml) & 0.5ml of dexamethasone (4mg/ml) was given in all cases.

Eye was padded and patched.

FIG. 4: SURGEON PERFORMING CATARACT SURGERY.

POST-OPERATIVE FOLLOW-UP

All patients were put on dexamethasone + chloramphenicol eye drops 8 times/day in tapering doses for 6 weeks and tropicamide with phenylephrine eye drops 2 times/day for 1 week.

Follow up assessment of the patients were done on the 1st day, 7th day and end of 6 weeks post operatively.

During follow up, ocular examination included the following points:

1. Uncorrected Visual acuity.
2. Best corrected Visual acuity.
3. Wound healing.
4. Corneal clarity.
5. Intraocular lens placing.

6. Fundus visibility.

7. Keratometric reading using Bosch-Lomb keratometer.

Pre and post-operative astigmatism was calculated from the difference of keratometric readings in the horizontal and vertical meridians (Kh and Kv).

Thus surgically induced astigmatism was calculated using SIA calculator 2.1 software.

STATISTICAL ANALYSIS

Unpaired t-test was applied to find out the significant difference of Surgically Induced Astigmatism, Uncorrected and Best Corrected Visual Acuity between the two techniques and to analyze the results of the study. P value less that 0.05 was considered as statistically significant. All the data was compiled and statistics done using SPSS for windows.

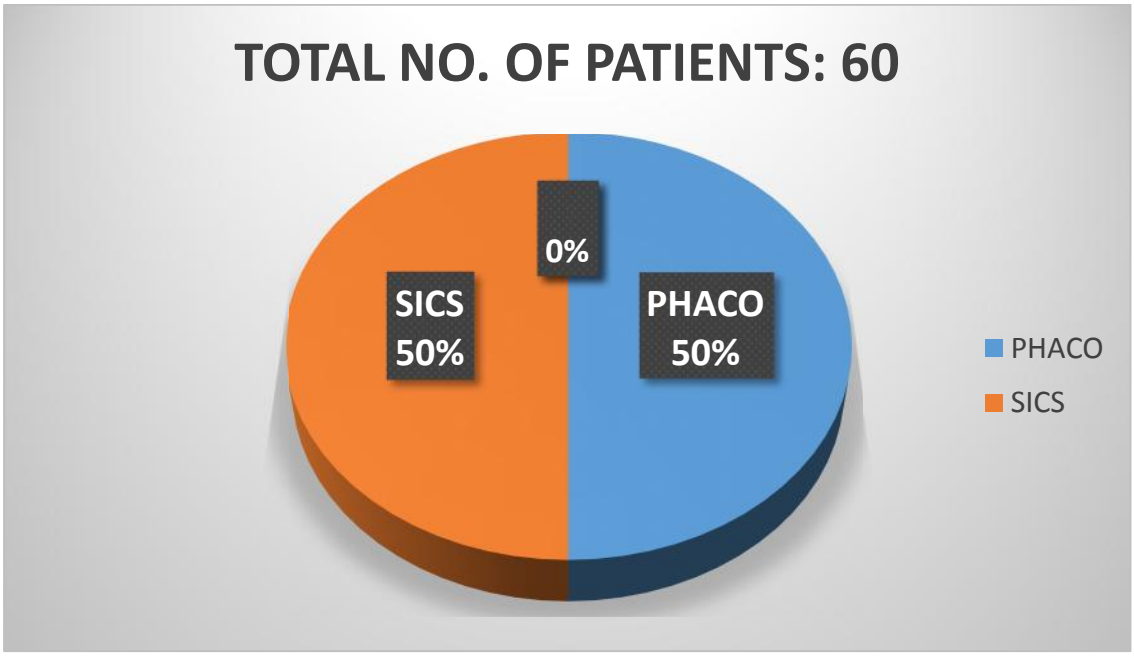
OBSERVATIONS AND RESULTS

1. NO. OF PATIENTS IN STUDY GROUP.

TABLE 1: DISTRIBUTION OF PATIENTS IN STUDY GROUPS

GROUP	NO. OF PATIENTS	PERCENTAGE
Phacoemulsification	30	50
Small Incision Cataract Surgery	30	50
TOTAL	60	100

GRAPH 1: DISTRIBUTION OF PATIENTS IN STUDY GROUPS



The patients were divided into 2 study groups in this randomized controlled trial. One group underwent phacoemulsification and the other group underwent manual SICS.

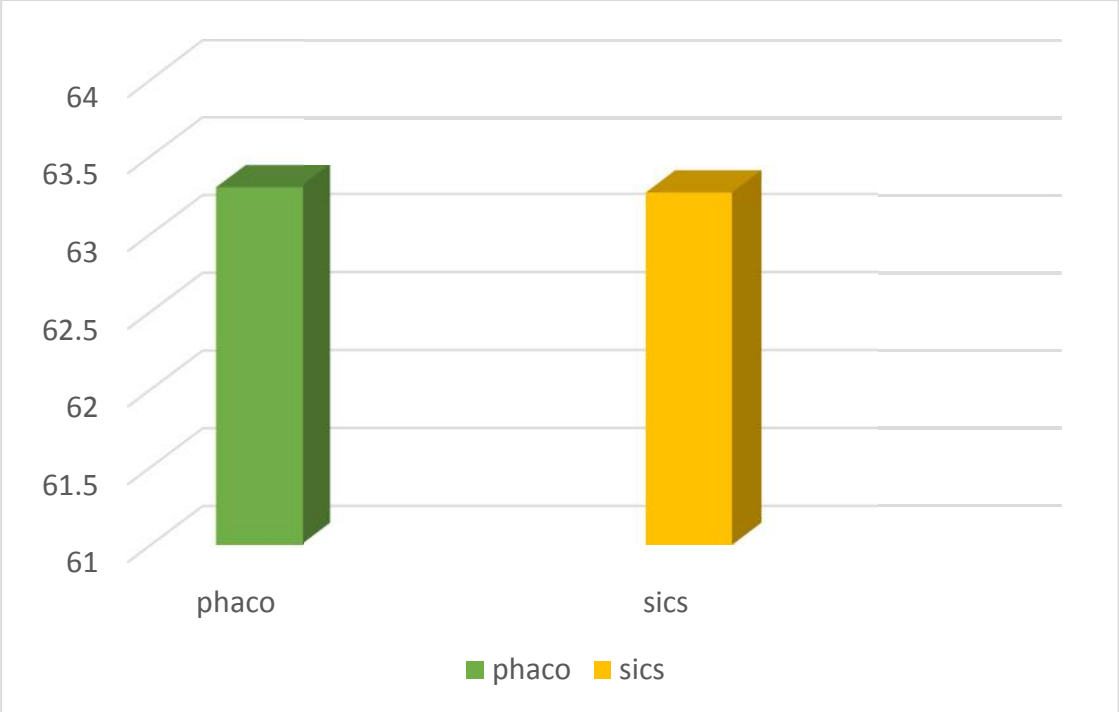
Sixty patients were included in the study, of which thirty underwent phacoemulsification while thirty underwent SICS.

2. MEAN AGE OF PATIENTS IN THE STUDY GROUPS

TABLE 2: MEAN AGE OF PATIENTS IN THE STUDY GROUPS

GROUP	AGE RANGE (in years)	MEAN AGE (in years)
Phacoemulsification	51-82	63.30
Small Incision Cataract Surgery	45-78	63.26
TOTAL	45-82	63.28

GRAPH 2: MEAN AGE OF PATIENTS IN THE STUDY GROUPS.



Age of patients ranged from 51-82 years in PHACO group and the mean age in PHACO group was 63.3 years.

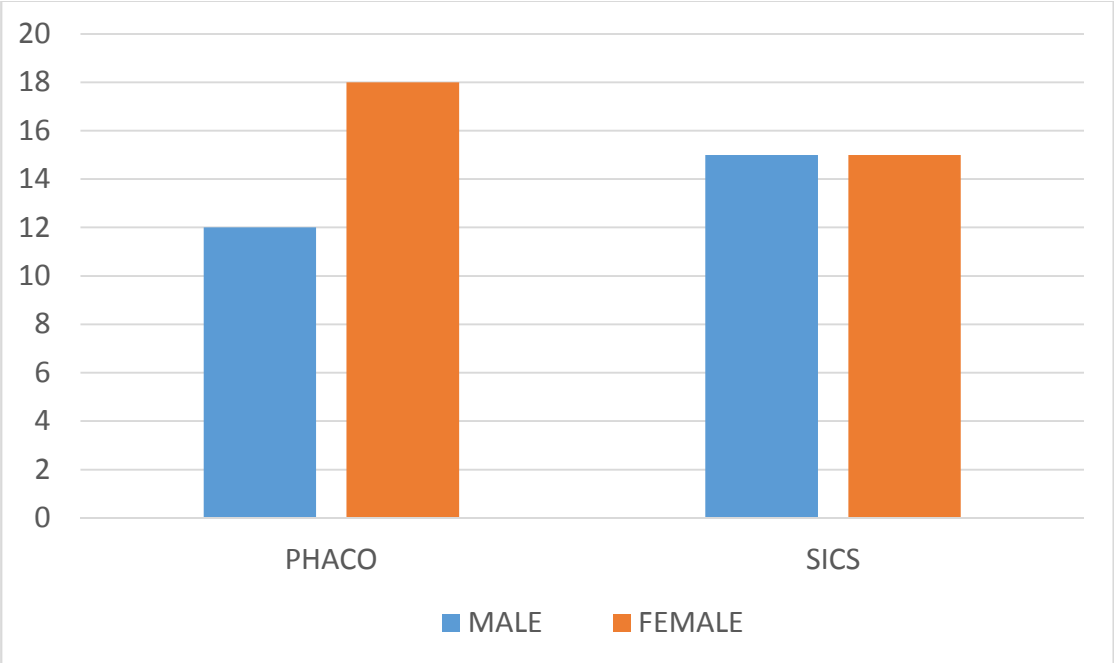
Age of patients in SICS group ranged from 45-78 years and the mean age was 63.27 years.

3. GENDER DISTRIBUTION IN THE STUDY GROUPS.

TABLE 3: GENDER DISTRIBUTION IN THE STUDY GROUPS

GENDER	PHACO		SICS		TOTAL	
	Number	%	Number	%	Number	%
MALE	12	40	15	50	27	45
FEMALE	18	60	15	50	33	55

GRAPH 3: GENDER DISTRIBUTION IN THE STUDY GROUPS.



In PHACO group males were 40% (n=12) and females were 60% (n=18). The male: female ratio was 2:3 in phaco group.

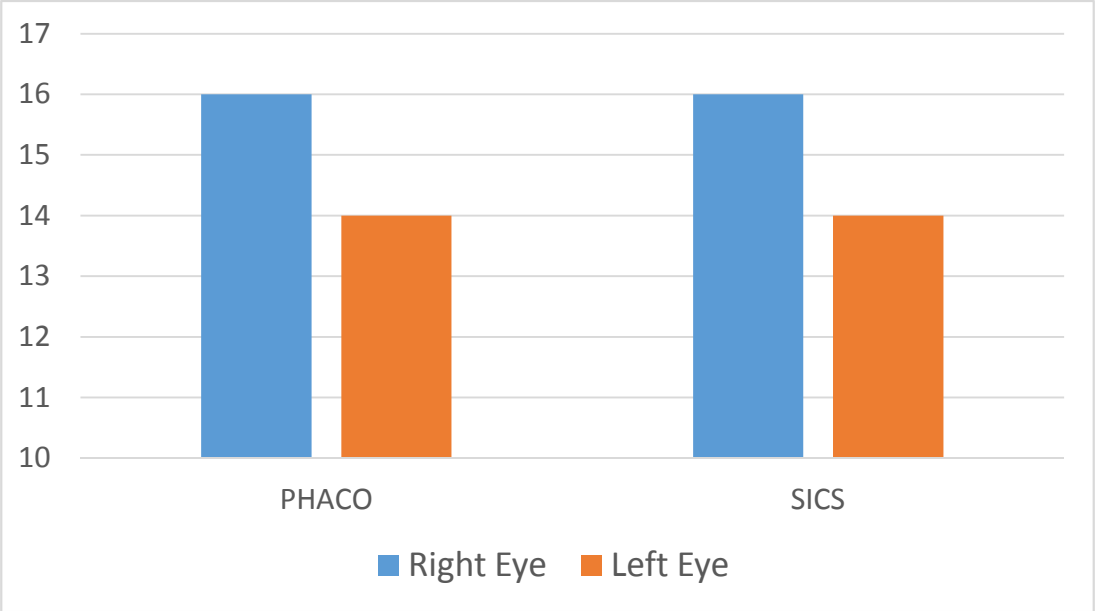
In SICS group males were 50 %(n=15) and females were 50 %(n=15). The male: female ratio was 1:1 in SICS group.

4. LATERALITY OF EYE IN STUDY GROUPS

TABLE 4: LATERALITY OF EYE IN STUDY GROUPS

GROUP	Right Eye	Left Eye
PHACO	16	14
SICS	16	14
TOTAL	32	28
PERCENTAGE	53.3	46.7

GRAPH 4: LATERALITY OF EYE IN STUDY GROUPS



In PHACO group, 16 patients were operated for Right eye and 14 for left eye.

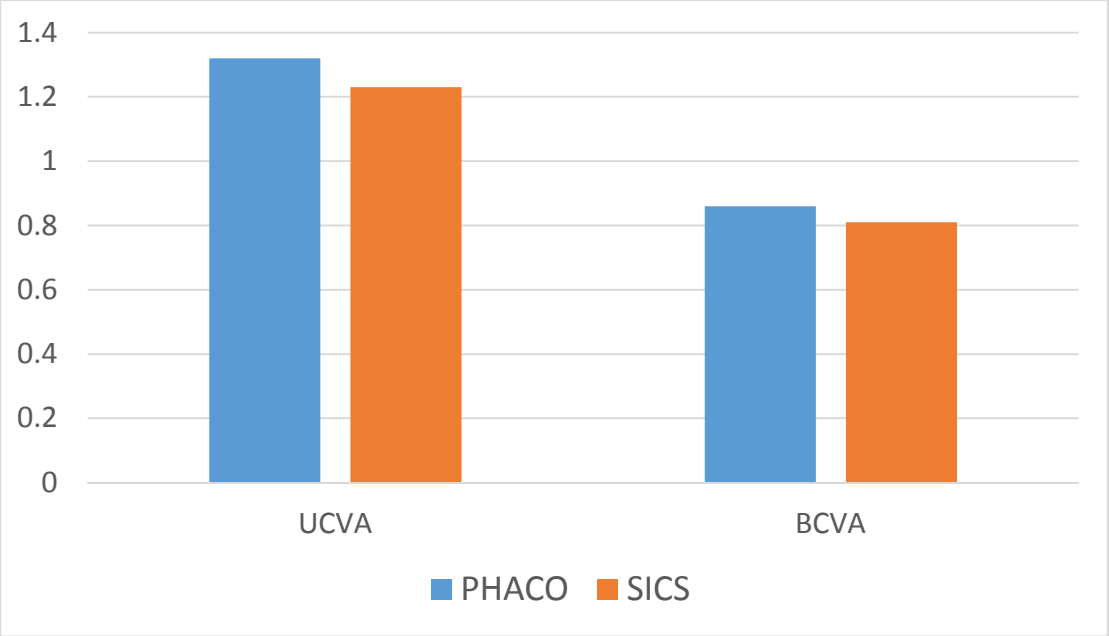
In SICS group, 16 patients were operated for Right eye and 14 for left eye.

5. PRE-OPERATIVE VISUAL ACUITY IN BOTH STUDY GROUPS

TABLE 5: COMPARISON OF MEAN PRE-OPERATIVE VISUAL ACUITY IN LOGMAR IN BOTH STUDY GROUPS

	MEAN VISUAL ACUITY (IN logMAR)		
	PHACO	**SICS**	**TOTAL**
MEAN UCVA	1.32	1.23	1.27
MEAN BCVA	0.86	0.81	0.83

GRAPH 5: COMPARISON OF MEAN PRE-OPERATIVE VISUAL ACUITY IN LOGMAR IN BOTH STUDY GROUPS



The mean pre-operative UCVA in PHACO group was 1.32 and in SICS group it was 1.23.

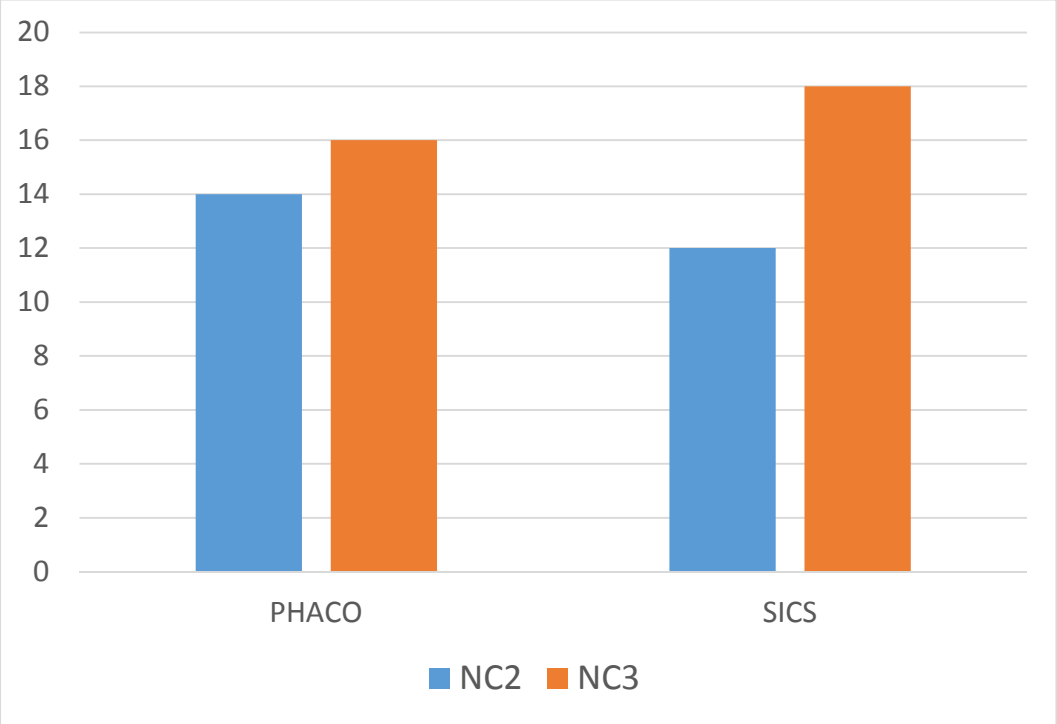
The mean pre-operative BCVA in PHACO group was 0.86 and in SICS group it was 0.81.

6. NUCLEUS OPALESCENCE (NC) GRADING IN BOTH GROUPS

TABLE 6: NUCLEUS OPALESCENCE (NC) GRADING IN BOTH GROUPS

GRADING	PHACO		SICS		TOTAL	
	No.	%	No.	%	No.	%
NC2	14	46.7	12	40	26	43.3
NC3	16	53.3	18	60	34	56.7

GRAPH 6: NUCLEUS OPALESCENCE (NC) GRADING IN BOTH GROUPS.



All the patients in both groups had nuclear opalescence grade 2 or grade 3.

In the Phaco group, 14 patients had NC 2 and 16 patients had NC 3 pre-operatively.

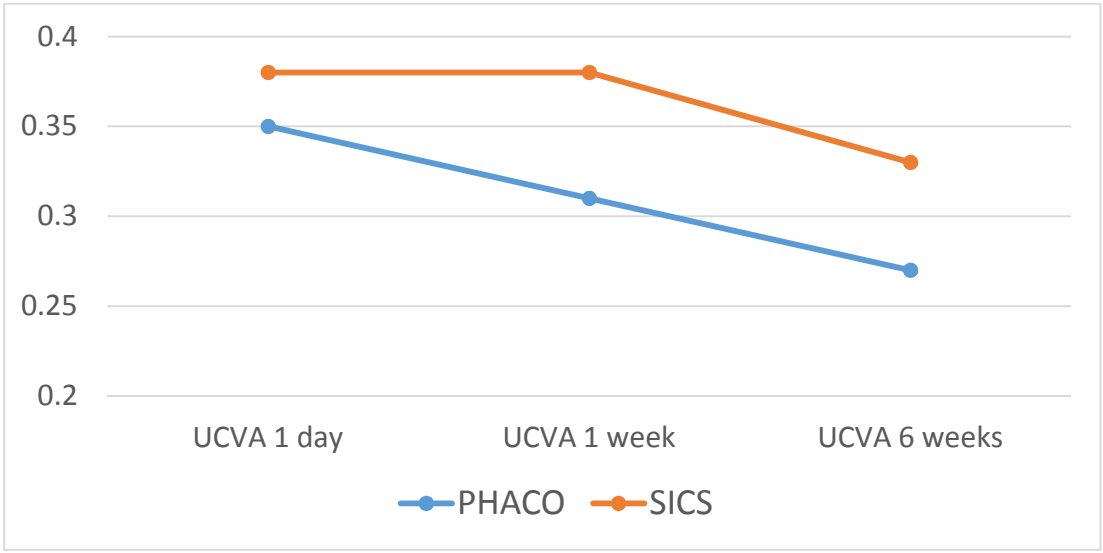
In the SICS group, 12 patients had NC 2 and 18 patients had NC 3 pre-operatively.

7. POST OPERATIVE VISUAL ACUITY IN BOTH GROUPS.

TABLE 7: COMPARISON OF MEAN POST OPERATIVE DISTANT VISUAL ACUITY IN BOTH GROUPS

GROUP	VISUAL ACUITY (in logMAR)					
	1 DAY POST-OP		1 WEEK POST-OP		6 WEEKS POST-OP	
	UCVA	BCVA	UCVA	BCVA	UCVA	BCVA
PHACO	0.35	0.14	0.31	0.11	0.27	0.04
SICS	0.38	0.19	0.38	0.13	0.33	0.10
P-value	0.504	0.127	0.044	0.437	0.108	0.012

GRAPH 7A: COMPARISON OF MEAN POST OPERATIVE DISTANT UCVA (IN logMAR) IN BOTH GROUPS.

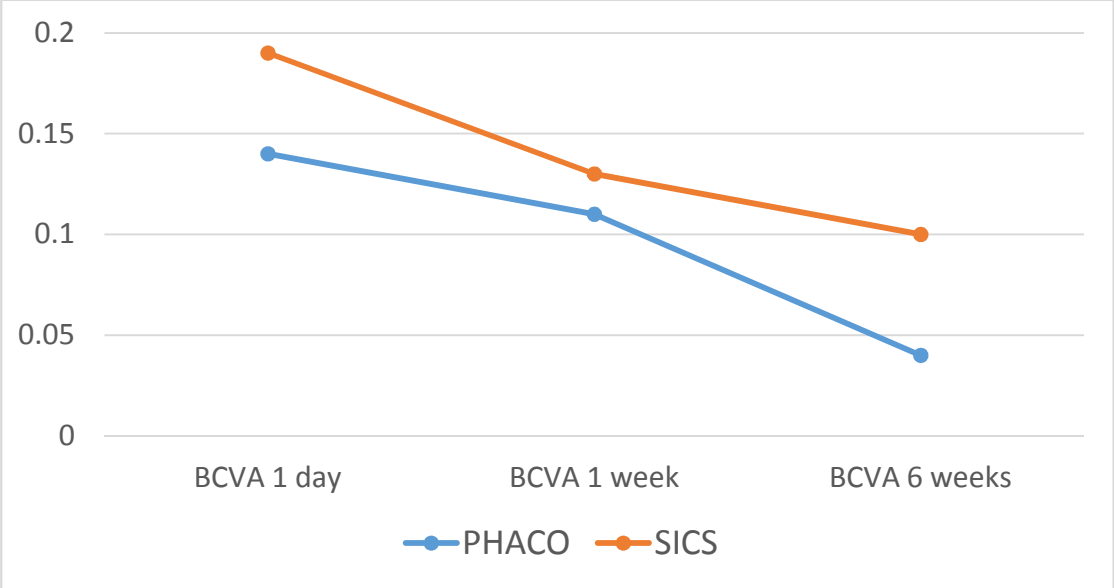


In PHACO group the mean Un-corrected Visual Acuity in logMAR during first postoperative day, 1 week postoperatively and 6 weeks post-operatively was 0.35, 0.31 and 0.27 respectively.

In SICS group the mean Un-corrected Visual Acuity in logMAR during first postoperative day, 1 week postoperatively and 6 weeks post-operatively was 0.38, 0.38 and 0.33 respectively.

The difference of mean Un-Corrected Visual Acuity between PHACO and SICS on post-op follow up at 1 week was statistically significant (P=0.44).

GRAPH 7B: COMPARISON OF MEAN POST OPERATIVE DISTANT BCVA (IN logMAR) IN BOTH GROUPS



In PHACO group the mean Best-corrected Visual Acuity in logMAR during first postoperative day, 1 week postoperatively and 6 weeks post-operatively was 0.14, 0.11 and 0.04 respectively.

In SICS group the mean Best-corrected Visual Acuity in logMAR during first postoperative day, 1 week postoperatively and 6 weeks post-operatively was 0.19, 0.13 and 0.10 respectively.

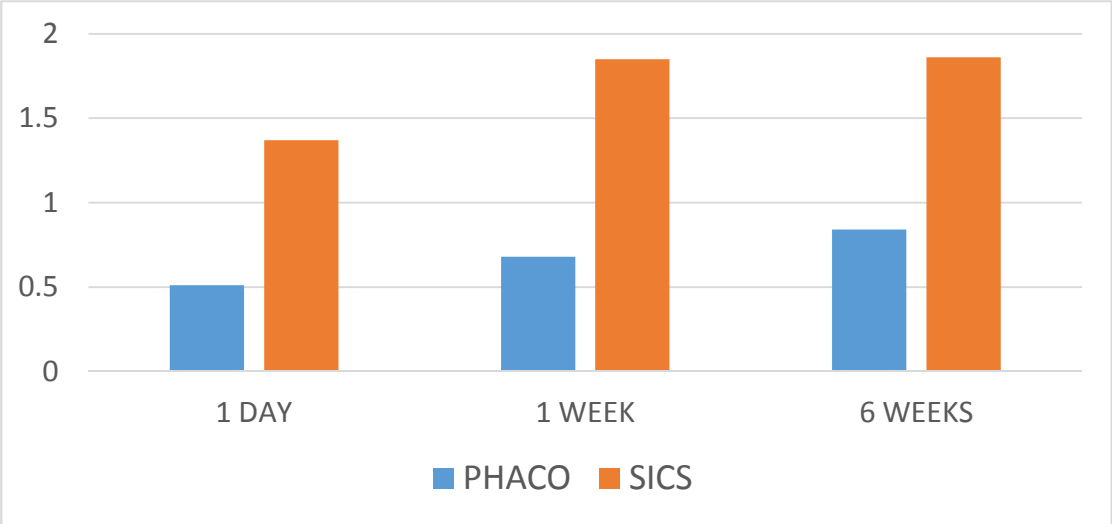
At 6 weeks post-op follow-up, mean BCVA logMAR difference between PHACO and SICS was statistically significant (P=0.012).

8. SURGICALLY INDUCED ASTIGMATISM (SIA) BETWEEN BOTH THE GROUPS.

TABLE 8: COMPARISON OF MEAN SURGICALLY INDUCED ASTIGMATISM BETWEEN BOTH GROUPS

GROUP	SIA at 1 Day Post-Op (in Diopters)	SIA at 1 Week Post-Op (in Diopters)	SAT at 6 Weeks Post-Op (in Diopters)
PHACO	0.51	0.68	0.84
SICS	1.37	1.65	1.86
P-Value	0.000	0.000	0.000

GRAPH 8: COMPARISON OF MEAN SURGICALLY INDUCED ASTIGMATISM BETWEEN BOTH GROUPS



In the PHACO group, at post-op day 1, 1 week post-operatively and 6 weeks post-operatively, mean SIA was 0.51D, 0.68D and 0.84D respectively.

In the SICS group, at post-op day 1, 1 week post-operatively and 6 weeks post-operatively, mean SIA was 1.37D, 1.65D, and 1.86D respectively.

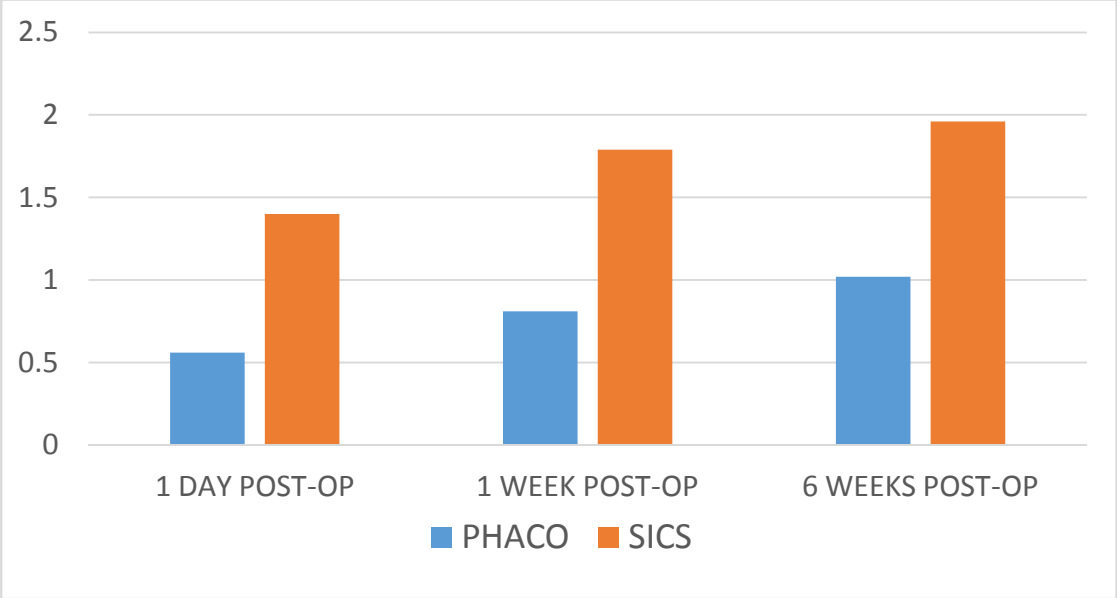
The difference of mean SIA between the two groups was statistically significant at post-op day 1, post-op 1 week and post-op 6 weeks ($P<0.05$). Post-operatively, mean induced astigmatism in the phacoemulsification group was significantly lower than in small incision cataract surgery group.

9. SURGICALLY INDUCED ASTIGMATISM (SIA) WITH RESPECT TO TYPE OF PRE-OP ASTIGMATISM

TABLE 9A: COMPARISON OF MEAN SURGICALLY INDUCED ASTIGMATISM BETWEEN TWO GROUPS IN PRE-OPERATIVE WTR ASTIGMATISM.

GROUP	MEAN SURGICALLY INDUCED ASTIGAMTISM (IN DIOPTERS)			
	NO. OF PATIENTS	1 DAY POST-OP	1 WEEK POST-OP	6 WEEKS POST-OP
PHACO	16	0.56	0.81	1.02
SICS	18	1.40	1.79	1.96

GRAPH 9A: COMPARISON OF SURGICALLY INDUCED ASTIGMATISM BETWEEN TWO GROUPS IN PRE-OPERATIVE WTR ASTIGMATISM.

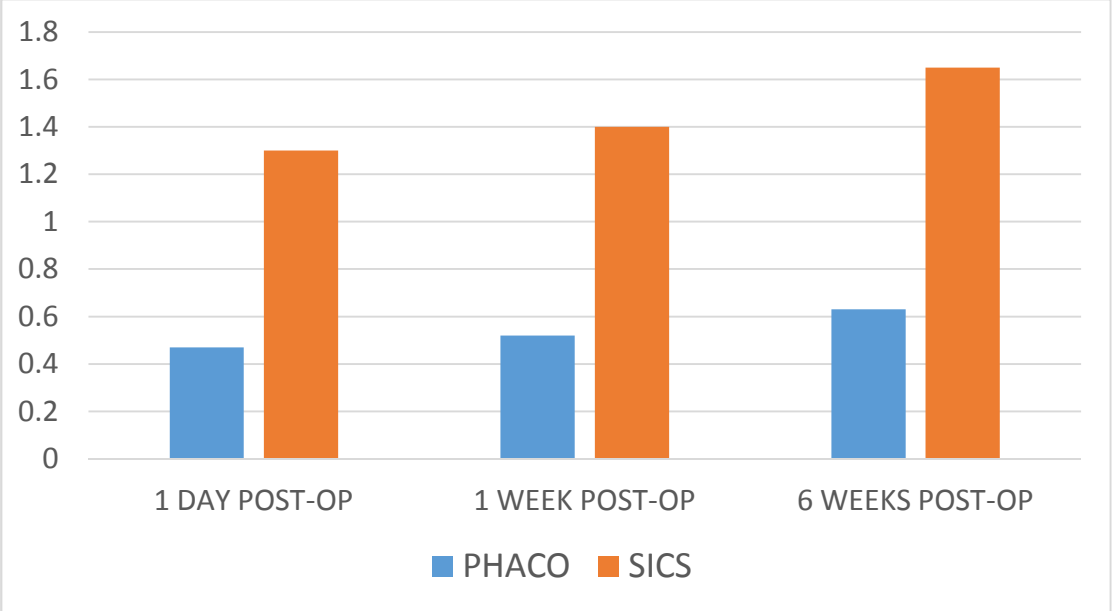


Among the patients with pre-existing WTR astigmatism, the mean SIA in PHACO group (n=18) was 0.53, 0.79 and 0.99 Diopters at 1 day, 1 week and 6 weeks post-op respectively. While in SICS group (n=20), the mean SIA was 1.40, 1.78 and 1.98 Diopters at 1 day, 1 week and 6 weeks post-op respectively.

TABLE 9B: COMPARISON OF MEAN SURGICALLY INDUCED ASTIGMATISM BETWEEN TWO GROUPS IN PRE-OPERATIVE ATR ASTIGMATISM.

GROUP	MEAN SURGICALLY INDUCED ASTIGAMTISM (IN DIOPTERS)			
	NO. OF PATIENTS	1 DAY POST-OP	1 WEEK POST-OP	6 WEEKS POST-OP
PHACO	12	0.48	0.52	0.63
SICS	10	1.30	1.40	1.65

GRAPH 9B: COMPARISON OF SURGICALLY INDUCED ASTIGMATISM BETWEEN TWO GROUPS IN PRE-OPERATIVE ATR ASTIGMATISM.



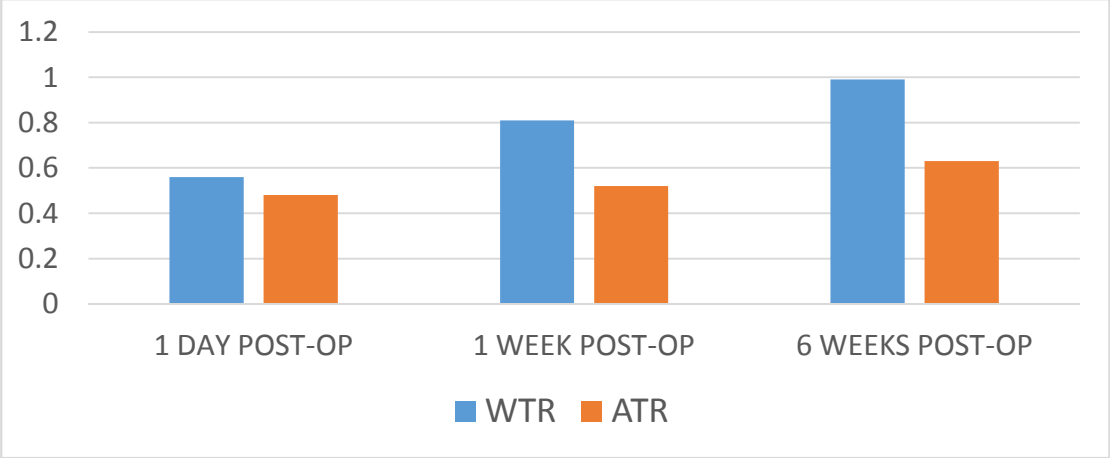
In the patients with pre-existing ATR astigmatism, the mean SIA in PHACO group (n=12) was 0.47, 0.52 and 0.63 Diopters at 1 day, 1 week and 6 weeks post-op respectively. While in SICS group (n=10), the mean SIA was 1.30 D, 1.40 D and 1.65 D at 1 day, 1 week and 6 weeks post-op respectively.

Four patients had no pre-operative astigmatism.

TABLE 9C: COMPARISON OF MEAN SURGICALLY INDUCED ASTIGMATISM BETWEEN PATIENTS WITH PRE-OPERATIVE WTR AND ATR ASTIGMATISM IN PHACO GROUP

TYPE OF PRE-OP ASTIGMATISM	MEAN SURGICALLY INDUCED ASTIGAMTISM IN PHACO GROUP (IN DIOPTERS)			
	NO. OF PATIENTS	1 DAY POST-OP	1 WEEK POST-OP	6 WEEKS POST-OP
WTR	16	0.56	0.81	1.02
ATR	10	0.48	0.52	0.63
P-VALUE		0.438	0.015	0.000

GRAPH 9C: COMPARISON OF SURGICALLY INDUCED ASTIGMATISM BETWEEN PATIENTS WITH PRE-OPERATIVE WTR AND ATR ASTIGMATISM IN PHACO GROUP

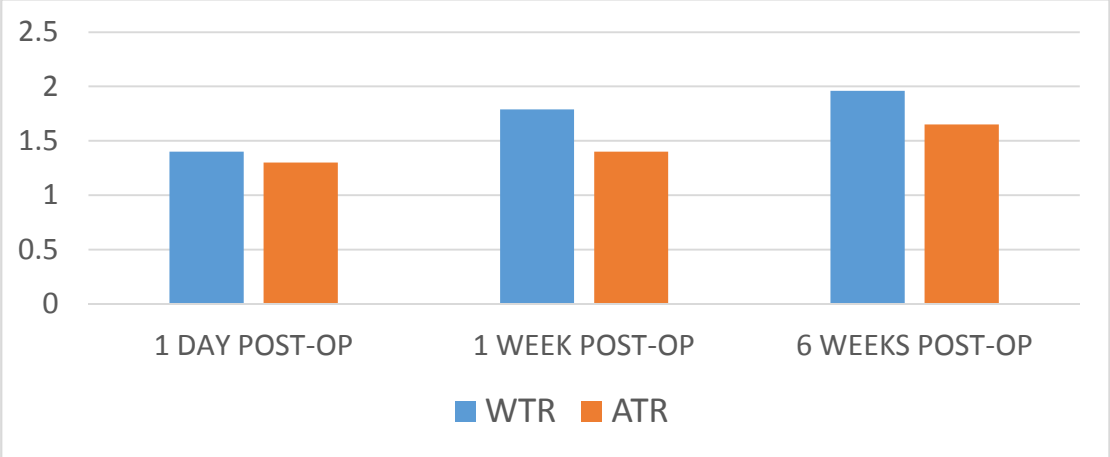


In patients with pre-operative WTR astigmatism, the mean SIA at post-op follow-ups at 1 day, 1 week and 6 weeks was 0.56 D, 0.81 D and 1.02 D respectively. In patients with pre-operative ATR astigmatism, the mean SIA at post-op follow-ups at 1 day, 1 week and 6 weeks was 0.48 D, 0.53 D and 0.63 D respectively. The difference of SIA in PHACO group with pre-operative WTR astigmatism was statistically significant at 1 week (p=0.015) and 6 weeks (p=0.000) post-operatively.

TABLE 9D: COMPARISON OF MEAN SURGICALLY INDUCED ASTIGMATISM BETWEEN PATIENTS WITH PRE-OPERATIVE WTR AND ATR ASTIGMATISM IN SICS GROUP

TYPE OF PRE-OP ASTIGMATISM	MEAN SURGICALLY INDUCED ASTIGAMTISM IN SICS GROUP (IN DIOPTERS)			
	NO. OF PATIENTS	1 DAY POST-OP	1 WEEK POST-OP	6 WEEKS POST-OP
WTR	18	1.40	1.79	1.96
ATR	10	1.30	1.40	1.65
P-VALUE		0.576	0.059	0.145

GRAPH 9D: COMPARISON OF SURGICALLY INDUCED ASTIGMATISM BETWEEN PATIENTS WITH PRE-OPERATIVE WTR AND ATR ASTIGMATISM IN SICS GROUP



In patients with pre-operative WTR astigmatism, the mean SIA at post-op follow-ups at 1 day, 1 week and 6 weeks was 1.40 D, 1.79 D and 1.96 D respectively. In patients with pre-operative ATR astigmatism, the mean SIA at post-op follow-ups at 1 day, 1 week and 6 weeks was 1.30 D, 1.40 D and 1.65 D respectively. The difference of SIA in SICS group with pre-operative WTR astigmatism was not statistically significant at the follow-ups on 1 day, 1 week and 6 weeks postoperatively.

SIA in patients with pre-operative WTR astigmatism was higher than those with pre-operative ATR astigmatism in both PHACO and SICS.

DISCUSSION

Surgeries for cataract are constantly developing. From ancient surgeries like Couching to modern surgeries like Femtosecond Laser Assisted Cataract Surgery (FLACS), the goal of a cataract surgery has always been to give clear vision to the patient. Patients who undergo cataract surgeries want less dependence on spectacles, at least for distance vision. Presence of astigmatism after cataract surgery can cause blurred images and glare. This astigmatism can be residual or surgically induced. The change in the corneal curvature is responsible for SIA and the astigmatic refractive error. Corneal astigmatism has always been a by-product of cataract surgery. It can create patient discomfort and dissatisfaction with otherwise uneventful cataract surgery.

To attain the goal of clear unaided vision to the patient, SIA has to be reduced. The cataract surgeon nowadays aims at this modification.

Comparison of SIA between PHACO and SICS was the main aim of this study. The groups were also compared with regard to UCVA and BCVA at respective follow-ups. SIA, UCVA and BCVA were compared between phacoemulsification (with superior limbal incision) and SICS (with superior scleral incision) at 1 day, 1 week and 6 weeks postoperatively.

Astigmatism was assessed by using keratometery readings and SIA was calculated with SIA Calculator 2.1 Microsoft Excel sheet calculator.[57]

In the present study, mean age for patients undergoing cataract surgery was 63.20 years in phacoemulsification and 63.26 years for SICS. This is similar to Pallavi patil et al.[58] who reported a mean age of 61 (±8) years in phaco group and 63 (±10) years in sics group, R Anand et al.[59] who reported the mean age of the patients at

61.79±9.82 years and Semanyenzi et al.[48] who reported the mean age at surgery was 57.8 years for phaco group and 63.4 years for SICS.

In the present study, 55% of the participants were females (n=33) and 45% males (n=27). This is similar to study by Khabir Ahmad et al.[60] who also showed a higher proportion of women than men undergoing cataract surgery.

The laterality of eyes in this study was 53.3% for right eye and 46.7% for left eye, which is similar to Pallavi Patil et al.[58]

In this study, the mean pre-operative UCVA in PHACO group was 1.32 logMAR while that in SICS group was 1.23 logMAR. The pre-operative BCVA in PHACO group was 0.86 logMAR and in SICS group it was 0.81 logMAR. The mean pre-operative visual acuity of patients in both the groups was comparable.

In this study, all the cases had Nuclear Opalescence grade II or Grade III pre-operatively. 43.3% of patients had NC 2 and 56.7 % of patients had NC 3.

In the present study, phacoemulsification achieved a better uncorrected as well as best corrected visual outcome as compared to SICS. Mean UCVA in PHACO group was 0.35, 0.30 and 0.27 logMar at 1 day, 1 week and 6 weeks post-op respectively, while that in SICS group was 0.38, 0.38, 0.33 logMar at 1 day, 1 week and 6 weeks post-op respectively, which is comparable to studies done by Singh et al. (2009)[37] and Ruit S et al.[35] and SE Semanyenzi et al [48].

In the present study, mean BCVA in PHACO group was 0.14, 0.11, 0.04 logMar at 1 day, 1 week and 6 weeks post-op respectively, while that in SICS group was 0.19, 0.13, 0.10 logMar at 1 day, 1 week and 6 weeks post-op respectively. The difference of BCVA at 6 weeks post-op between the two groups was statistically

significant ($p<0.05$). This is similar to studies done by Colin cook et al. in 2012 [41] who found that BCVA at the end of 8 weeks was higher in PHACO than in SICS.

On comparing the type of astigmatism induced, the present study found a significant change to against the rule (ATR) astigmatism in both the superior incision PHACO and superior incision SICS groups. No oblique astigmatism was encountered post-operatively. This is similar to results reported by Singh et al.[37] and Ruit S et al.[35]

The mean SIA in the present study in PHACO group patients at 1 day, 1 week and 6 weeks post-operatively was 0.51 D, 0.68 D and 0.84 D respectively. This is similar to results reported by Gross RH[61] and Barequet et al.[62] who reported SIA to be 0.60 D and 0.74 D respectively after 6 weeks. Masket S et al.[63] and Mohd. Pakravan et al[64] found SIA to be 0.63±0.30 D and 0.67±0.48 D which is also comparable to this study. However, the SIA in present study was higher when compared to Pfleger T et al[65] and Oshika T et al [66] who reported a SIA of 0.22 D in their studies.

In this study, the mean SIA of the SICS group patients at 1 day, 1 week and 6 weeks post-operatively was 1.37 D, 1.65 D and 1.86 D respectively. These findings are similar to that of Malik et al[42] (1.45 ± 0.73 D at the end of 6 weeks) who used a superior incision, It is also similar to studies done by Parikshit Gogate et al.[67], Nikhil S Gokhale et al.[68], Reddy B et al.[36] and Ankur gupta et al.[45]. George R et al [69] found the SIA to be 1.17D after 6 weeks which is lesser than the present study.

In the present study mean SIA was 0.84 D for PHACO group and 1.87 D for SICS group at the end of 6 weeks. The magnitude of difference was 1.03 D which was statistically significant. This is similar to George R et al.[69], who concluded that Phacoemulsification induced less astigmatism than SICS.

This study also compared the SIA induced in relation to meridian of pre-operative astigmatism, i.e., WTR (Steep meridian at 90 degrees) and ATR (Steep meridian at 180 degrees). In PHACO group, the mean SIA in patients with pre-operative WTR astigmatism was 0.56 D, 0.81 D and 1.02 D at 1 day, 1 week and 6 weeks post-op respectively which was higher than SIA in patients with pre-operative ATR astigmatism, i.e., 0.48 D, 0.52 D and 0.63 D at 1 day, 1 week and 6 weeks post-op respectively. In SICS group, the mean SIA in patients with pre-operative WTR astigmatism was 1.40 D, 1.79 D and 1.96 D at 1 day, 1 week and 6 weeks post-op respectively which was higher than SIA in patients with pre-operative ATR astigmatism, i.e., 1.30 D, 1.40 D, and 1.65 D at 1 day, 1 week and 6 weeks post-op respectively. Four patients did not have any pre-operative astigmatism. The difference of SIA in PHACO group between patients with pre-operative WTR and ATR astigmatism was statistically significant at 1 week (p=0.015) and 6 weeks (p=0.000) post-operatively. In SICS group, the SIA in pre-operative WTR astigmatism patients was higher than pre-operative ATR astigmatism on follow-ups on 1day, 1 week and 6 weeks post-operatively, but was not statistically significant. Thus the SIA induced in patients with pre-operative WTR astigmatism was higher than that in patients with pre-operative ATR astigmatism, in both the groups. This is similar to study conducted by Özyol E et al.[70]

Reshma Ramakrishnan et al.[52] in 2017 did a study aiming at comparison of corneal changes between SICS and phacoemulsification and concluded that surgically induced astigmatism was a significantly higher in SICS which is similar to the present study.

It is evident thus that there exists wide variations in the reported SIA in studies by different authors. These differences can be due to variations in surgical techniques as well as different periods of postoperative follow-up.

At 6 weeks, the present study found significantly less SIA and consequently, significantly better BCVA in those who underwent Phaco as compared to SICS. This indicated that when the incision was made in the same meridian, SICS induced more astigmatism as compared to Phaco. More the incision size, higher the SIA as there is scarring and flattening of the cornea at the incision site and also this may be due to lesser rate of inflammation and astigmatism in phacoemulsification group.

CONCLUSION

This aim of this study was to compare the Surgically Induced Astigmatism and the post-operative uncorrected and best-corrected visual acuity between Phacoemulsification and SICS.

Phacoemulsification group had a lower mean surgically induced astigmatism than SICS on all follow-ups which were all statistically significant ($p<0.000$). Phacoemulsification induces lesser Surgically Induced Astigmatism (SIA) as compared to the SICS, when incisions in both groups are made at the same meridian. this is due to difference in size of incision as there is scarring and flattening of the cornea at the incision site.

Phacoemulsification group had a higher mean Uncorrected Visual Acuity (UCVA) at 1 week post-operative than SICS group which was statistically significant ($p=0.044$) and higher Best Corrected Visual Acuity (BCVA) at 6 weeks which was statistically significant ($p=0.012$).

Thus we concluded that Phacoemulsification gives better visual outcome than SICS with minimal astigmatism.

Small incision cataract surgery was safe and was nearly as effective as phacoemulsification in terms of visual outcome to the patient. Even though it induced higher astigmatism than Phacoemulsification it provided patients with good vision after cataract surgery.

SUMMARY

Cataract is the leading cause of avoidable blindness in India and is responsible for up to 50-80 percent cases of bilateral blindness. The two most common techniques used for cataract extraction nowadays are small incision cataract surgery (SICS) and phacoemulsification.

Presence of astigmatism after cataract surgery can cause blurred images and glare. This astigmatism can be residual or surgically induced. The change in the corneal curvature after surgery is responsible for SIA and the astigmatic refractive error.

Length of incision and site of incision are the two major factors affecting the induced astigmatism. The purpose of this study is to evaluate and compare the surgically induced astigmatism between Phacoemulsification and SICS and to compare the visual acuity of patients after surgery in both these techniques.

This study, a one year randomized trial, was conducted at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre on patients with age related cataracts who attended the ophthalmology OPD in the hospital from 1 January 2017 to 31 December 2017. Patients with senile cataracts without any other ocular pathology were selected and divided randomly into two groups. One group underwent Phacoemulsification while the other group underwent SICS. Phacoemulsification was done using a 3.2 mm superior limbal incision and SICS using a 6 mm superior scleral incision. All the patients were followed up at 1 day, 1 week and 6 weeks post-operatively.

The mean age of patients who underwent phacoemulsification was 63.20 years and those who underwent SICS was 63.26 years. 55% of all patients were females as compared to 45% males. 32 patients underwent cataract surgery in the right eye and

28 in the left eye. The mean pre-operative uncorrected visual acuity in phaco group was 1.32 logMAR while that in SICS group was 1.23 logMAR. The mean pre-operative best corrected visual acuity in PHACO group was 0.86 logMAR and in SICS group was 0.81 logMAR. All the patients had Nuclear Opalescence grade 2 or grade 3. In the Phaco group, 14 patients had NC 2 and 16 patients had NC 3 pre-operatively. In the SICS group, 12 patients had NC 2 and 18 patients had NC 3 pre-operatively.

In this study, the patients who underwent phacoemulsification had mean uncorrected visual acuity as 0.35, 0.30 and 0.27 logMAR at 1 day, 1 week, and 6 weeks post-operative respectively while those who underwent SICS had a mean visual acuity of 0.38, 0.38 and 0.33 logMAR at 1 day, 1 week, and 6 weeks post-operative respectively. Using unpaired t test, it was found that the difference of mean UCVA at 1 week was significant ($p<0.05$), while at follow-ups done at 1 day and 6 weeks, it was not significant.

Best corrected visual acuity in patients who underwent Phacoemulsification was 0.14, 0.11 and 0.04 logMAR at 1 day, 1 week and 6 weeks post-operative respectively. Those who underwent SICS had a mean best corrected visual acuity of 0.19, 0.13 and 0.10 logMAR respectively. The difference of best corrected visual acuity at 6 weeks post-operative followup was statistically significant ($p<0.05$) as calculated by unpaired T test.

The astigmatism induced in both the groups in this study was against the rule (ATR). The surgically induced astigmatism in Phaco group was 0.84 ± 0.30 D, while that in SICS group was 1.87 ± 0.53 D. The difference of the astigmatism induced was highly significant ($p<0.000$).

The SIA in patients with pre-operative with the rule (WTR) astigmatism in PHACO group at follow-ups done on 1 day, 1 week and 6 weeks post-operatively was 0.56 D, 0.81 D and 1.02 D respectively and in those with pre-operative against the rule (ATR) astigmatism at follow-ups done on 1 day, 1 week and 6 weeks post-operatively was 0.48 D, 0.52 D and 0.63 respectively. In SICS group with pre-operative WTR astigmatism, the SIA at follow-ups done on 1 day, 1 week and 6 weeks post-operatively was 1.40 D, 1.79 D and 1.96 D respectively and in those with pre-operative ATR astigmatism at follow-ups done on 1 day, 1 week and 6 weeks post-operatively was 1.30 D, 1.40 D and 1.65 D respectively. The difference of SIA in PHACO group between patients with pre-operative WTR and ATR astigmatism was statistically significant at 1 week ($p=0.015$) and 6 weeks ($p=0.000$) post-operatively, while that in SICS group was not statistically significant. Thus the SIA in patients with pre-operative WTR astigmatism was higher than in those with pre-operative ATR astigmatism in both the study groups.

This study indicated that Phacoemulsification induces lesser astigmatism than SICS when incisions are made in the same meridian. The size of incision affects astigmatism as there is scarring and flattening of the cornea at the incision site.

The best corrected visual acuity at 6 weeks in phacoemulsification was significantly higher than that of SICS. Thus Phacoemulsification gives better visual outcome than SICS with minimal astigmatism.

Even though it induces higher astigmatism than Phacoemulsification, SICS gives good visual outcome to the patients and is a safe and effective technique for performing cataract surgeries.

BIBLIOGRAPHY

1. Finger RP. Cataracts in India: current situation, access, and barriers to services over time. Ophthalmic Epidemiol. 2007 Jun;14(3):112–8.
2. Chander A, Baveja A, Batra N, et al. Evaluation of visual outcome of cataract surgery in eye camps. J. Evid. Based Med. Healthc. 2017; 4(43), 2611-2614.
3. Gogate P, Deshpande M, Nirmalan PK.Why do phacoemulsification? Manual small-incision cataract surgery is almost as effective, but less expensive. Ophthalmology. 2007 May; 114(5):965-8.
4. Elliot RH. Indian operation of couching for cataract. Br J Ophthalmol.1917;1:64-5
5. Grzybowski A and Ascaso F J. Sushruta in 600 B.C. introduced extraocular expulsion of lens material. Acta Ophthalmol. 2014: 92: 194–197.
6. Ascaso FJ, Huerva V. The History of Cataract Surgery. Cataract Surgery, 6:75-90, on-line, 2013.
7. Apple DJ, Sims J. Harold Ridley and the invention of the intraocular lens. Surv Ophthalmol. 1996 Jan-Feb;40(4):279-92.
8. Obstbaum SA. Charles D. Kelman, MD (1930-2004). Arch Ophthalmol. 2005;123(2):287–288.
9. P. Mishra, S. Manavalan, M. Ramya, M. Jeevitha, R. Vinnarasi, Latha Priyangaa, V. Sridevi, R. Parth. Manual Small Incision Cataract Surgery (MSICS). J of Evolution of Med and Dent Sci. 2014:3:46 Sep, 11249-11261.
10. Lal H. A guide to Phacoemulsification. New Delhi. AIOS CME series (No. 21). 2010.
11. Burrato L. Phacoemulsification. 2nd ed. Thorofare, N.J.: Slack. 2002.

12. K Ravi Reddy K, Satyavani P. Section 3 phacoemulsification. Chapter eighteen. Atlas of Cataract Surgery, first edition. : Jaypee brothers medical publishers (p) ltd; 2008; page 79-84.
13. Henning A, Kumar J, Yorston D, Foster A. Suture less cataract surgery with nucleus extraction: outcome of a prospective study in Nepal. Br J Ophthalmol. 2003; 87:266–270.
14. Hennig, A., Kumar, J., Singh, A. K., Ansari, A., Singh, S., Gurung, R., Foster, A. World Sight Day and cataract blindness. Br J Ophthalmol. 2002 Jul; 86(7): 830–831.
15. Goel R, Malik KPS. Manual Small Incision Cataract Surgery. New Delhi; AIOS, CME series (NO. 8).
16. I. Howard Fine, Mark Packer, Richard S. Hoffman. Chapter 47, Small incision cataract surgery, section 4, part 4, volume-1, Myron Yanoff, Jay S. Duker, second edition, Elsevier Publication ; pg-349-350.
17. Natchiar G. Capsulotomy, chapter-4.4, Manual Small Incision Cataract Surgery an alternative technique to instrumental Phacoemulsification. Aravind Publication, 2000; pg-19-20.
18. Priglinger SG, Palanker D, Alge CS, Kreutzer TC, Haritoglou C, Grueterich M, et al. Pulsed electron avalanche knife: new technology for cataract surgery. Br J Ophthalmol. 2007; 91(7):949–54.
19. Izak AM, Werner L, Pandey SK, Apple DJ, Izak MGJ. Analysis of the capsule edge after Fugo plasma blade capsulotomy, continuous curvilinear capsulorhexis, and can-opener capsulotomy. J Cataract Refract Surg. 2004; 30(12):2606–11.

20. Natchiar G. Nucleus extraction, chapter-4.6, Manual Small Incision Cataract Surgery an alternative technique to instrumental Phacoemulsification. Aravind Publication, 2000; pg-25-30.
21. Dong X, Chen W, Wang H, Söderberg PG. Forceps-guided nuclear cleavage cataract extraction. J Cataract Refract Surg. 2002; 28(8):1320–4.
22. Mishra P, Thanikachalam S. chapter 21, Micro Vectis Technique. Small Incision Cataract Surgery (manual phaco), First Edition. Jaypee Brothers Medical Publishers, pg-113-116.
23. Rajeev Vaish. Chapter nineteen, Modified Fishhook Technique. Small Incision Cataract Surgery (manual phaco), First Edition, Jaypee Brothers Medical Publishers, pg-107-109.
24. Amesbury EC, Miller KM. Correction of astigmatism at the time of cataract surgery. Curr Opin Ophthalmol. 2009 Jan;20(1):19–24.
25. Naeser K. Assessment and statistics of surgically induced astigmatism. Acta Ophthalmol. 2008 May;86(3):349.
26. Holladay JT, Moran JR, Kezirian GM. Analysis of aggregate surgically induced refractive change, prediction error, and intraocular astigmatism. J Cataract Refract Surg. 2001 Jan;27(1):61–79.
27. Sarver EJ, Van Heugten TY, Padrick TD, Hall MT. Astigmatic refraction using peaks of the interferogram Fourier transform for a Talbot Moiré interferometer. J Refract Surg. 2007 Nov;23(9):972–7.
28. Naeser K, Hjortdal J. Polar value analysis of refractive data. J Cataract Refract Surg. 2001 Jan;27(1):86–94.

29. Moon SC, Mohamed T, Fine IH. Comparison of surgically induced astigmatisms after clear corneal incisions of different sizes. Korean J Ophthalmol.2007; 21(1):1-5.

30. Altan-Yaycioglu R, Akova YA, Akca S, Gur S, Oktem C. Effect on astigmatism of the location of clear corneal incision in phacoemulsification of cataract. J Refract Surg. 2007; 23(5):515–8.

31. Altan-Yaycioglu R, Pelit A, Evyapan O, Akova YA. Astigmatism induced by oblique clear corneal incision: right vs left eyes. Can J Ophthalmol.2007; 42(4):557-561.

32. Prajna N V, Chandrakanth KS, Kim R, Narendran V, Selvakumar S, Rohini G, et al. The Madurai Intraocular Lens Study. II: Clinical outcomes. Am J Ophthalmol .1998; 125(1):14–25.

33. Oshika T, Shimazaki J, Yoshitomi F, Oki K, Sakabe I, Matsuda S, et al. Arcuate keratotomy to treat corneal astigmatism after cataract surgery. Ophthalmology. 1998; 105(11):2012–6.

34. Gogate PM, Deshpande M, Wormald RP, Deshpande R, Kulkarni SR. Extracapsular cataract surgery compared with manual small incision cataract surgery in community eye care setting in western India: A randomized controlled trial. Br J Ophthalmol. 2003; 87(6):667–72.

35. Ruit S, Tabin J, Chang D, Bajracharya L, Kline C, Richheimer W, Shrestha M, and Paudyal, G. A Prospective Randomized Clinical Trial of Phacoemulsification vs. Manual Suture less Small-Incision Extracapsular Cataract Surgery. Am J Ophthalmol. 2007; 143(1):32-38.

36. Reddy B, Raj A, Singh VP. Site of incision and corneal astigmatism in conventional SICS versus phacoemulsification. Ann Ophthalmol. 2007; 39(3):209–16.
37. Singh SK, Winter I, Surin L. Phacoemulsification versus small incision cataract surgery (SICS): which one is a better surgical option for immature cataract in developing countries? Nepal J Ophthalmol. 2009 Jul-Dec; 1(2):95-100.
38. Venkatesh R, Tan CS, Sengupta S, Ravindran RD, Krishnan KT, Chang DF. Phacoemulsification versus manual small-incision cataract surgery for white cataract. J Cataract Refract Surg. 2010 Nov; 36(11):1849-54.
39. Visser N, Nuijts RMMA, De Vries NE, Bauer NJC. Visual outcomes and patient satisfaction after cataract surgery with toric multifocal intraocular lens implantation. J Cataract Refract Surg. 2011; 37(11):2034–42.
40. Jongsareejit A, Wiriyaluppa C, Kongsap P, Phumipan S. Cost-effectiveness analysis of manual small incision cataract surgery (MSICS) and phacoemulsification (PE). J Med Assoc Thail. 2012; 95(2):212–20.
41. Colin Cook, Henri Carrara, and Landon Myer. Phaco-emulsification versus manual small-incision cataract surgery in South Africa. Afr Med J.2012; 102(6):537-540.
42. Malik V, Kumar S, Kamboj R, Jain C, Jain K, Kumar S. Comparison of astigmatism following manual small incision cataract surgery: superior versus temporal approach. Nepal J Ophthalmol. 2012; 4(1):54–8.
43. Zhang JY, Feng YF, Cai JQ. Phacoemulsification versus manual small- incision cataract surgery for age-related cataract: meta-analysis of randomized controlled trials. Clin Exp Ophthalmol. 2013 May-Jun; 41(4):379-86.

44. Saber H. El-Sayeda, Hoda M.K. El-Sobkya, Nermeen M. Badawya, Eslam A.A. El-Shafyb. Phacoemulsification versus manual small incision cataract surgery for treatment of cataract. Menoufia Med J .2015; 28:191–196.
45. Gupta A, Arora I, Kumar D, Gupta D. Surgically Induced Astigmatism in 2.8 mm, 5.3 mm Phacoemulsification and 6.0 mm Manual Small Incision Cataract Surgery. Journal of Evolution of Medical and Dental Sciences. 2014; 3(19):5283-5290.
46. Iqbal S, Riaz SM, Menon A, Krishnan P, Kiran KR. Visual Outcome and Complications in Small Incision cataract Surgery and Phacoemulsification. Nat. J of Med. And Allied science. 2015;4(1)1-6
47. Gogate P, Optom J, Deshpande S, Naidoo K. Meta-analysis to compare the safety and efficacy of manual small incision cataract surgery and phacoemulsification. Middle East Afr J Ophthalmol. 2015; 22(3):362-9.
48. Semanyenzi, S. E. Outcome after small Incision Cataract Surgery (SICS) and Phacoemulsification at KIGALI UNIVERSITY TEACHING HOSPITAL. Rwanda Medical Journal .2015; 72(4): 12-16.
49. Jaggernath J, Swapna D, Naidoo K. Meta-analysis to compare the Safety and Efficacy of Manual Small Incision Cataract Surgery and Phacoemulsification. Middle East Afr J Ophthalmol. 2015 Jul-Sep; 22(3): 362–369.
50. Zi Ye, Shou-Zhi He, Zhao-Hui Li .Efficacy comparison between manual small incision cataract surgery and phacoemulsification in cataract patients: a meta-analysis. Int J ClinExp Med. 2015;8(6):8848-8853
51. Amitava A, Khan A, Rizvi SA, Siddiqui Z, Kumari N, Grover S. Cost-effectiveness analysis should continually assess competing health care options especially in high volume environments like cataract surgery. Indian J Ophthalm. 2015; 63(6):496.

52. Venkatesh R, van Landingham SW, Khodifad AM, Haripriya A, Thiel CL, Ramulu P, et al. Carbon footprint and cost–effectiveness of cataract surgery. Curr Opin Ophthalmol. 2016; 27(1):82–8.
53. Yu Y-B, Zhu Y-N, Wang W, Zhang Y-D, Yu Y-H, Yao K. A comparable study of clinical and optical outcomes after 1.8, 2.0 mm micro coaxial and 3.0 mm coaxial cataract surgery. Int J Ophthalmol. 2016; 9(3):399–405.
54. Ashish B, Prajapati T, Patel A. Corneal topography and astigmatism evaluation following small incision cataract surgery and phacoemulsification. Int J Int Med Res.2017; 4(1):17–22.
55. Ramakrishna R, Shah P, Srivastava S, Parik D. Comparison of corneal changes between SICS and phacoemulsification. Int J of Ocular Onc and Ocul. 2017 Jan-Mar; 3(1):50-53.
56. Ramalakshmi V, Rani MRH, Rajalakshmi A, Anandan H. Comparison of Merits and Demerits of Manual Small Incision Cataract Surgery with Phacoemulsification. Int J Sci Stud. 2017; 4(12):161-163.
57. Sawhney S. SIA Calculator [Internet]. Insight Eye Clinic. Availabale from : http://www.insighteyeclinic.in/SIA_calculator.php.
58. Patil P, Radhakrishnan O, Rajappa N, Lune A, Magdum R. Evaluation and comparison of surgically induced astigmatism between phacoemulsification and small incision cataract surgery. Sudan J Ophthalmol. 2013;5(2):67
59. Anand R, Gupta A, Ram J, Singh U, Kumar R. Visual outcome following cataract surgery in rural Punjab. Indian J Ophthalmol. 2000; 48(2):153–8.
60. Ahmad K, Zwi AB, Tarantola DJM, Soomro AQ, Baig R, Azam SI. Gendered disparities in quality of cataract surgery in a marginalized population in Pakistan:

The Karachi marine fishing community's eye and general health survey. PLoS One. 2015; 10(7).

61. Gross RH, Miller KM. Corneal astigmatism after phacoemulsification and lens implantation through unsutured scleral & corneal funnel incision. Am J Ophthalmol. 1996; 121:57-64.
62. Barequet IS, Yu E, Vitale S, Cassard S, Azar DT, Stark WJ. Astigmatic outcomes of horizontal temporal versus nasal clear corneal incision cataract surgery. J Cataract Refract Surg. 2004; 30: 418-423.
63. Masket S, Wang L, Belani S. Induced astigmatism with 2.2- and 3.0-mm coaxial phacoemulsification incisions. J Refract Surg.2009; 25(January):21–4.
64. Pakravan M, Nikkhah H, Yazdani S, Shahabi C, Sedigh-Rahimabadi M. Astigmatic outcomes of temporal versus nasal clear corneal phacoemulsification. J Ophthalmic Vis Res. 2009; 4(2):79–83.
65. Pfleger T, Scholz U, Scorpik C. Postoperative astigmatism after no stitch, small incision cataract surgery with 3.5 mm and 4.5 mm incisions. J Cataract Refract surgery. July 1994, 20(4): 400-405.
66. Oshika T. Three year prospective, randomised evaluation of IOL implantation through 3.2 mm and 5.5 mm incision. JCRS 1998; 24(4):509-514.
67. Gogate PM, Kulkarni SR, Krishnaiah S, Deshpande RD, Joshi SA, Palimkar A, et al. Safety and efficacy of phacoemulsification compared with manual small-incision cataract surgery by a randomized controlled clinical trial: Six-week results. Ophthalmology. 2005; 112(5):869–74.
68. Gokhale N, Sawhney S. Reduction in astigmatism in manual small incision cataract surgery through change of incision site. Indian J Ophthalmol. 2005; 53(3):201.

69. George R, Rupauliha P, Sripriya A V., Rajesh PS, Vahan PV, Praveen S. Comparison of endothelial cell loss and surgically induced astigmatism following conventional extracapsular cataract surgery, manual small-incision surgery and phacoemulsification. Ophthalmic Epidemiol. 2005; 12(5):293–7.
70. Özyol E, Özyol P. The relation between superior phacoemulsification incision and steep axis on astigmatic outcomes. Int Ophthalmol. 2012 Dec;32(6):565-70.

CONSENT FOR PARTICIPATION IN RESEARCH

STUDY ID NO. ☐☐☐

Mr./Mrs./Ms._____

You are invited to participate in our research study titled **"Comparative Study of Surgically Induced Astigmatism in Small Incision Cataract Surgery and Phacoemulsification – A one year Randomized Controlled Trial at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi."** Conducted by Dr. _____, Post Graduate in M.S. Ophthalmology under the guidance of Dr. _____, MS, DOMS, Ph.D., Professor and Head in the department of Ophthalmology, J.N. Medical College, Belagavi.

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

Introduction to the Study:- Cataract is the leading cause of avoidable blindness worldwide. The reasons for this is lack of access to eye care, lack of resources and specially trained surgeons, to deliver cataract surgery safely, and reliably. Two most common techniques used nowadays for cataract extraction are Small Incision Cataract Surgery (SICS) and Phacoemulsification. Phacoemulsification is a newer technique but involves high cost of setup and is difficult to learn whereas Small Incision

Cataract Surgery (SICS) is much more economical and is therefore used for majority of cataract surgeries in India. The visual outcome of both the techniques has been shown to be comparable in previous studies.

Purpose of the study: - The purpose of the research is to compare the surgically induced astigmatism and Post-Operative Uncorrected and Best Corrected Visual acuity in Small Incision Cataract Surgery and Phacoemulsification.

Procedure Involved: - If you agree to enroll yourself in this study, you will be asked to give detailed history. Then you will be clinically examined in detail by slit-lamp examination, fundoscopy, tonometry for measurement of intraocular pressure. Syringing for patency of the lacrimal sac, keratometry and A-scan ultrasonography and investigations like Blood Pressure measurement, Random Blood sugar will be done. Then you will be undergoing small incision cataract surgery (SICS) or Phacoemulsification. You will be asked to follow up on specified dates when your progress would be monitored and documented.

Risks and Benefits: - Rare complications of cataract surgery includes endophthalmitis, vitreous loss, globe perforation, retro bulbar hemorrhage, expulsive choroidal hemorrhage for which all necessary precautions will be taken.

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

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

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

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

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

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

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

1) Chief Investigator, Dr. _____, P.G, Department of Ophthalmology, JNMC, Belagavi. Contact No. _____

2) Dr. _____., Guide, Professor and Head, Department of Ophthalmology, JNMC, Belagavi. Contact No. _____

3) Dr. Ganga Pilli. Chairperson of Ethical Committee, Professor, Dept. of Pathology, J.N.Medical College, KLE University, Belgavi. Contact No. 948027601

Consent for participation in research trial

I, Mr./Ms./Mrs. _____

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

Subject Name: _____

Signature / Left Thumb Print of Subject: _____

Witness Name: _____

Signature / Left Thumb Print of Witness: _____

Investigators Name: _____

Signature of Investigator: _____

Name of the Guide: - DR._____

Signature of the guide: - _____

Date: _____

Place: _____

संशोधन में भाग लेने केलिए सम्मती पत्र.

आपको इस संशोधन **"कंप्यारीटीव स्टडी ऑफ सर्जीकली इंडयुसीड अस्टीगमेटिस्म इन स्मॉल इन्सियेशन क्याटरयाक्ट सर्जी ऍन्ड प्याकोएमुलसीपीकेशन सर्जी: ए वन इयर रँडमाईज्ड कंट्रोल्ड ट्रैल एट के.एल.ई. डॉ. प्रभाकर कोरे हॉस्पिटल और एम.आर.सी. बेलगावी"** , में भाग लेने के लिये निमंत्रित करता हु । ये संशोधन, **डॉ. अंकीत अग्रवाल,** पी.जी. विद्यार्थी, जे.एन. मेडीकल कॉलेज बेळगावी. और मार्गदर्शक : **के , प्रोफेसर ऍन्ड हेड, अप्तामलॉजी विभाग,** जे.एन. मेडीकल कॉलेज बेळगावी. द्वारा किया जा रहा है ।

मुझे इस संशोधन के बारे में और इसके फायदे और इसके रिस्क पुरे तरिके से बतादिये गये है ।

मै अपनी मर्जी से संशोधन में भाग लेना चाहता हुं और इसके लिये मेरी सहमती है । मैं अपनी मर्जी से कभी भी संशोधन में भाग लेने के लिये मना कर सकता हुँ । मेरे पास संशोधन के बारे मे प्रश्न पुछने के लिये पूरा समय है और इसके लिय मैं कभी भी प्रश्न पुछ सकता हुँ ।

मेरा साक्षरी / अगूंठा साक्षी है कि मै सहमती पत्र के लिय तैयार हूँ ।

इस विषय पर और अधिक जानकारी केलिये या संपर्क किजिए

१. **मुख्य संशोधक, डॉ.** पी.जी. विद्यार्थी, अप्तामलॉजी विभाग, जे.एन. मेडीकल कॉलेज बेळगावी जे.एन. मेडीकल कॉलेज बेळगावी । मो –

२. **डॉ. प्रोफेसर ऍन्ड हेड, अप्तामलॉजी विभाग**, जे.एन. मेडीकल कॉलेज बेळगावी । **मो–**

अगर आपको इस अध्ययन में भाग लेनेवालों के हक के बारे मे अधिक जानकारि चाहिए तो इन वैद्य को संपर्क कर सकते हैं ।

डॉ. गंगा. एस. पिळहै. चेअरमन, इन्स्टिटूशनल एथिक्स कमिटीम, प्रोफेसर, पॅथॉलाजी विभाग, जे.एन. मेडीकल कॉलेज, बेळगावी । मो–९४८०२७५६०१

सम्मती पत्र

मै नीचे सही करनेवाला स्वेइच्छेसे इस अभ्यासमें भाग लेने के लिए मान्यता देता हूँ । मै अपना नाम किसी भी वक्त इसमेसे वापस ले सकता हूँ और इस सम्मती के कारण मै मेरे कोई भी कानूनी हक नहीं छोड रहा हूँ। यह सब उपर के विषय के बारे में स्वयं पढकर या पढने के, सुनने के बाद मैं इस सम्मती पत्र पर अपने हस्ताक्षर कर के सभी प्रश्नों का उत्तर है रहा हूँ ।

सहभागी का नाम :

हस्ताक्षर :

साक्षीदार का नाम :

हस्ताक्षर :

संशोधक का नाम :

हस्ताक्षर :

दिनांक :

स्थळ :

संशोधन अभ्यास सहभाग संमती

संशोधन अध्ययन: "**कंप्यारीटीव स्टडी ऑफ सर्जीकली इंडयुसीड अस्टीगमेटिस्म इन स्मॉल इन्सियेशन क्याटरयाक्ट सर्जी ऍन्ड प्याकोएमुलसीपीकेशन सर्जी: ए वन इयर रँडमाईज्ड कंट्रोल्ड ट्रैल अट के. एल. ईज. डॉ. प्रभाकर कोरे हॉस्पिटल आणि एम.आर.सी. बेलगावि, एक अध्ययन**" **डॉ.** , पी.जी. विद्यार्थी, अप्तामलॉजी विभाग जे.एन. मेडीकल कॉलेज बेळगावी, द्वारा आयोजित **डॉ.** , **प्रोफेसर ऍन्ड हेड, अप्तामलॉजी विभाग**, जे.एन. मेडीकल कॉलेज बेळगावी यांच्या मार्गदर्शनाखाली करत आहेत.

प्रक्रिया सहभाग:

तुम्ही माझ्या अभ्यासात स्वत: नावनोंदणी करणेस सहमत असल्यास, नंतर वैद्यकीय तपासणी केली जाईल, आणि त्यानुसार तुमच्या सध्याच्या मागील आणि कुटुंबाचा इतिहास या संबंधित मुलाखत घेतली जाईल.

धोके आणि फ़ायदे

या अभ्यासातील धोके आणि फ़ायदे मला समजावून सांगितळे आहेत.

प्रलियेतीळ सहभाग

सहभाग ऐच्छिक आहे. आपण स्वत: ला या अभ्यासात सहभागीकरू शकता. किंवा नाकरू शकता.नाकारत्यास रूग्णोलयोशी असलेल्या सबंधात काही फरक पडणार नाही. तुम्ही या अभ्यासातून कधीही माघार घेऊ शकता

पर्याय : आपण अभ्यास सहभाग सोडला तरी आपत्याला रूग्णालयातीळ उपचार नियमा प्रमाणे मिळेतील.

गोपनीयता : तुम्ही. दिलेली संशोधनादरम्यानची माहिती ही फक्त संशोधन संघातील लोकांनाच माहित असेल. व संशोधन नापरली जाईल तुमच्या लेखी परवानगीशिवाय कोणतीच माहिती उघड केली जाणार नाही.

परिणाम छापण्याबाबत : संशोधनच्या परिणामांबाबत चर्चा करताना, तुमची ओळख पटेल अशी माहिती उघड केली जाणार नाही.

नुकसानभरपाई : काहीही आरोग्यिक नुकसान झाल्यास रूग्णालय कोणतीहीं आर्थिक नुकसानभरपाई देण्यास बद्ध नाही.

संशोधनाबाबत काहीही प्रश्न वा शंका असल्यास संपर्क साधावा :

१. **मुख्य संशोधक, डॉ.** , पी.जी. विद्यार्थी, अप्तामलॉजी विभाग, जे.एन. मेडीकल कॉलेज बेळगावी जे.एन. मेडीकल कॉलेज बेळगावी । मो –
२. **डॉ.** **प्रोफेसर ऍन्ड हेड, अप्तामलॉजी विभाग**, जे.एन. मेडीकल कॉलेज बेळगावी । **मो–**
३. **डॉ. गंगा. एस. पिळ्ळई. चेअरमन, इन्स्टिटूशनल एथिक्स कमिटी, प्रोफेसर, पॅथॉलाजी विभाग, जे.एन. मेडीकल कालेज, बेळगावी । मो–९४८०२७५६०१**

सम्मती पत्र

मी खाली सही करणार स्वत:हून अभ्यासामध्ये भाग घेण्यासाठी हे मान्य करत आहे. मी माझे नांव यातून कोणत्याही क्षणी काढून घेवू शकतो/शकते. हा नमूना फार्म सही केल्यामुळे मी माझे कोणतेही नैतिक अधिकार सोडून देत नाही आहे. हे वाचून पाहिल्यानंतर किंवा ते वाचून दाखविल्या नंतर मी माझी सही या सम्मती पत्रावर करत आहे. व अशा प्रकारे मी सर्व प्रश्नाची उत्तरे देत आहे.
भाग घेणायाचे नांव :

सही अथवा डाव्या हाताचा अंगठा :

साक्षीदाराचे नांव :

साक्षीदाराची सही :

तपासणान्याचे नांव :

तपासणान्याची सही :

तारीख: ठिकाण :

ಸಂಶೋಧನಾ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವಿಕೆಗಾಗಿನ ಸಮ್ಮತಿ ಪತ್ರ

ನಾವು ನಿಮ್ಮನ್ನು ಸಂಶೋಧನೆಯಲ್ಲಿ ತೊಡಗಿಸಿಕೊಳ್ಳಲು ವಿನಂತಿಸುತ್ತಿದ್ದೇವೆ **"ಕಂಪ್ಯಾರಿಟಿ ಸ್ಟಡಿ ಆಫ್ ಸರ್ಜಿಕಲ್ ಇಂಡ್ಯುಸಿಡ್ ಅಸ್ಟಿಗಮೇಟ್ಜಮ್ ಇನ್ ಸಮ್ಲಾ ಇನಸೀಯೆಶನ್ ಕ್ಯಾಟರ್ಯಾಕ್ಟ್ ಸರ್ಜರಿ & ಫ್ಯಾಕೋಎಮುಲಸಿಪಿಕೇಶನ್ ಸರ್ಜರಿ ಎ ಒನ್ ಇಯರ್ ರೆಂಡಮೈಜ್ಡ್ ಕಂಟ್ರೋಲ್ಡ್ ಟ್ರೈಲ್" ಆಟ್ ಕೆ.ಎಲ್.ಇ.ಎಸ್. ಡಾ॥ ಪ್ರಭಾಕರ ಕೋರೆ ಹಾಸ್ಪೀಟಲ್ ಮತ್ತು ಎಮ್.ಆರ್.ಸಿ. ಬೆಳಗಾವಿಯಲ್ಲಿ ಮಾಡುವ ಒಂದು ಅಧ್ಯಯನ" ಡಾ॥ , ಸ್ನಾತಕೋತ್ತರ ವಿದ್ಯಾರ್ಥಿ ಜೆ.ಎನ್.ಮೆಡಿಕಲ್ ಕಾಲೇಜು, ಬೆಳಗಾವಿ ಇವರು ಡಾ॥ ಪ್ರೊಫೇಸರ & ಹೆಡ್, ಅಪ್ತಾಮಲಾಜಿ ವಿಭಾಗ, ಜೆ.ಎನ್.ಮೇಡಿಕಲ್ ಕಾಲೇಜು, ಬೆಳಗಾವಿ,** ಇವರ ಮಾರ್ಗದರ್ಶದಲ್ಲಿ ನಡೆಸುತ್ತಿದ್ದೇವೆ.

ಗೌರವಾನ್ವಿತರೇ ನೀವು ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ಅರ್ಹರಿದ್ದಿರಿ.

ಸಂಶೋಧನೆಯಲ್ಲಿ ನಿಮ್ಮ ಭಾಗವಹಿಸುವಿಕೆ ವೈಯಕ್ತಿಕವಾಗಿದ್ದು, ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸುವುದು ನಿಮ್ಮ ನಿರ್ಧಾರವಾಗಿರುತ್ತದೆ. ಇದರಿಂದ ಜೆ.ಎನ್ ಮೇಡಿಕಲ್ ಕಾಲೇಜಿಗೆ ನಿಮಗಿರುವ ಸಂಬಂಧಕ್ಕೆ ಪರಿಣಾಮ ಬೀರುವುದಿಲ್ಲ. ನೀವು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಅಧ್ಯಯನದಿಂದ ಹಿಂದೆ ಸರಿಯಬಹುದು.

ನೀವು ನನ್ನ ಅಧ್ಯಯನದಲ್ಲಿ ನಿಮ್ಮನ್ನು ತೊಡಗಿಸಿಕೊಳ್ಳಲು ಒಪ್ಪಿದ ನಂತರ ಪ್ರಾಯೋಗಿಕವಾಗಿ ವಿಚಾರಣೆ ಹಾಗೂ ಅದಕ್ಕೆ ತಕ್ಕಂತೆ ತನಿಖೆ ನಡೆಸಲಾಗುವುದು. ನಿಮ್ಮ ಹಾಗೂ ಕುಟುಂಬದ ಇತಿಹಾಸದ ಬಗ್ಗೆ ಸಂಧರ್ಶನ ನಡೆಯಿಸಲಾಗುವುದು.

ತಾವುಗಳು ಈ ಸಂಶೋಧನೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವಾಗ ಮುನ್ನೆಚ್ಚರಿಕೆ ಕ್ರಮಗಳನ್ನು ಅನುಸರಿಸಲಾಗುವುದು. ಈ ಸಂಶೋಧನೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವುದರಿಂದ ಖಾಯಿಲೆಯ ಸಂಪೂರ್ಣ ಮಾಹಿತಿ ಪಡೆಯಬಹುದು. ಇದರಿಂದ ಇದೇ ಖಾಯಿಲೆಯಿಂದ ಬಳಲುತ್ತಿರುವ ಇತರರಿಗೆ ತುಂಬಾ ಸಹಾಯವಾಗುವುದು.

ಈ ಪರೀಕ್ಷೆಯ ವೆಚ್ಚವನ್ನು ಆಸ್ಪತ್ರೆಯ ನಿಯಮದಂತೆ ತಾವೇ ಭರಿಸಬೇಕು. ಆದರೆ ಇದರಲ್ಲಿ ಯಾವುದೇ ಇತರ ವೆಚ್ಚುಗಳು ಇರುವುದಿಲ್ಲ.

ತಾವು ಈ ಪರೀಕ್ಷೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವುದನ್ನು ಸಂಪೂರ್ಣವಾಗಿ ಗೌಪ್ಯವಾಗಿ ಇಡಲಾಗುವುದು.

ತಮ್ಮ ಖಾಯಿಲೆ ಹಾಗೂ ಸಂಶೋಧನೆಯ ವಿವರಗಳನ್ನು ಎಲ್ಲಿಯೂ ಬಹಿರಂಗಪಡಿಸಲಾಗುವುದಿಲ್ಲ. ಸಂಶೋಧನೆಯ ವಿವರಗಳನ್ನು ಪ್ರಕಟಿಸಲಿಕ್ಕೆ ಉಪಯೋಗ ಮಾಡಬಹುದು. ಆದರೆ ಇಲ್ಲಿ ನಿಮ್ಮ ಗೌಪ್ಯತೆಯನ್ನು ಕಾಪಾಡಲಾಗುವುದು. ಅಧ್ಯಯನಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಆಗುವ ಯಾವುದೇ ವ್ಯತಿರಿಕ್ತ ಪರಿಣಾಮಗಳಿಗೆ ಕೆ.ಎಲ್.ಇ.ಆಸ್ಪತ್ರೆಯ ಮೂಲಕ ಚಿಕಿತ್ಸೆ ನೀಡಲಾಗುವುದು.

ತಮಗೆ ಯಾವುದಾದರೂ ಸಂಶಯಗಳಿದ್ದಲ್ಲಿ ಅಥವಾ ಹೆಚ್ಚಿನ ಮಾಹಿತಿ ಬೇಕಾಗಿದ್ದಲ್ಲಿ ಈ ಕೆಳಗಿನ ವೈದ್ಯರನ್ನು ಸಂಪರ್ಕಿಸಬಹುದು.

(1) **ಡಾ॥ ', ಸ್ನಾತಕೋತ್ತರ ವಿದ್ಯಾರ್ಥಿ, ಅಪ್ತಾಮಲಾಜಿ ವಿಭಾಗ,** ಜೆ.ಎನ್.ಮೇಡಿಕಲ್ ಕಾಲೇಜ,

(2) **ಡಾ॥ ., ಪ್ರೊಫೇಸರ** & ಹೆಡ್ **, ಅಪ್ತಾಮಲಾಜಿ ವಿಭಾಗ, ಜೆ.ಎನ್.ಮೇಡಿಕಲ್ ಕಾಲೇಜ, ಬೆಳಗಾವಿ,** ಜೆ.ಎನ್.ಮೇಡಿಕಲ್ ಕಾಲೇಜ, ಬೆಳಗಾವಿ. (ಮೋ)

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸುವವರ ಹಕ್ಕುಗಳ ವಿವರಗಳಿಗಾಗಿ ಈ ಕೆಳಗಿನ ವೈದ್ಯರನ್ನು ಸಂಪರ್ಕಿಸಬಹುದು. **ಡಾ॥ ಗಂಗಾ ಎಸ್. ಪಿಳ್ಳೈ,** ಚೇರಮನ್, ಇನಸ್ಟಿಟ್ಯೂಶನಲ್ ಎಥಿಕ್ಸ್ ಕಮಿಟಿ. ಪ್ರೊಫೇಸರ. ಪೆಥಾಲಾಜಿ ವಿಭಾಗ, ಜೆ.ಎನ್.ಮೇಡಿಕಲ್ ಕಾಲೇಜ, ಬೆಳಗಾವಿ. (ಮೋ) 9480275601.

ಸಂಶೋಧನೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ಸ್ವ-ಒಪ್ಪಿಗೆ ಪ್ರಮಾಣ ಪತ್ರ :

ಈ ಸಂಶೋಧನೆಯ ಬಗ್ಗೆ ನನ್ನ ಸ್ವಂತ ಭಾಷೆಯಲ್ಲಿ ಸಂಪೂರ್ಣ ವಿವರವಾಗಿ ನನಗೆ ಅರ್ಥವಾಗಿರುತ್ತದೆ. ಈ ಸಂಶೋಧನೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ನನಗೆ ಸಂಪೂರ್ಣವಾದ ಒಪ್ಪಿಗೆ ಇರುತ್ತದೆ. ಈ ಸಂಶೋಧನೆ'ಯ ವಿವರಗಳು ಹಾಗೂ ಪರಿಣಾಮಗಳ ಬಗ್ಗೆ ನನಗೆ ಸಂಪೂರ್ಣವಾದ ಮಾಹಿತಿ ಇರುತ್ತದೆ. ಈ ಸಂಶೋಧನೆಯಲ್ಲಿ ಸ್ವ ಇಚ್ಛೆಯಿಂದ ಪಾಲ್ಗೊಳ್ಳಲು ಬಯಸುತ್ತೇನೆಂದು ಈ ಮೂಲಕ ದೃಢೀಕರಿಸುತ್ತೇನೆ. ನಾನು ಈ ಸಮ್ಮತಿ ಪತ್ರಕ್ಕೆ ಸಹಿ ಮಾಡುವುದರಿಂದ ನನಗೆ ಲಭ್ಯವಿರುವ ಕಾನೂನಿನ ಯಾವುದೇ ಹಕ್ಕುಗಳನ್ನು ಬಿಟ್ಟುಕೊಟ್ಟಿರುವುದಿಲ್ಲ. ನಾನು ಮೇಲಿನ ವಿಷಯ ಓದಿ ಅಥವಾ ಓದಿಸಿ ಕೇಳ ಸಮ್ಮತಿ ಪತ್ರದಲ್ಲಿರುವ ಎಲ್ಲ ಪ್ರಶ್ನೆಗಳಿಗೆ ಉತ್ತರಿಸಿರುತ್ತೇನೆ.

ಭಾಗವಹಿಸುವವರ ಹೆಸರು : _____

ಭಾಗವಹಿಸುವವರ ಸಹಿ : _____

ಭಾಗವಹಿಸುವವರ ಹೆಬ್ಬಟ್ಟಿನ ಗುರುತು : _____

ಸಾಕ್ಷಿದಾರರ ಹೆಸರು : _____

ಸಾಕ್ಷಿದಾರರ ಸಹಿ : _____

ಸಂಶೋಧಕರ ಹೆಸರು : _____

ಸಂಶೋಧಕರ ಸಹಿ : _____

ಸ್ಥಳ : _____

ದಿನಾಂಕ : _____

PROFORMA

PATIENTS ID NO: ☐☐☐

NAME: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

AGE: ☐☐ Years

SEX: ☐ (1-Male; 2-Female)

ADDRESS: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

CONTACT NUMBER:- ☐☐☐☐☐☐☐☐☐☐

OP NUMBER: ☐☐☐☐☐☐☐☐

IP NUMBER: ☐☐☐☐☐☐☐☐

DATE OF ADMISSION: ☐☐ / ☐☐ / ☐☐☐☐

DATE OF DISCHARGE: ☐☐ / ☐☐ / ☐☐☐☐

IS THE PATIENT ELIGIBLE FOR STUDY? (1-YES; 2-NO) ☐

HAS INFORMED CONSENT BEEN GIVEN? (1-YES; 2-NO) ☐

FINAL RESULT INFORMATION ☐

1- INELIGIBLE
2- ELIGIBLE- REFUSAL
3- ELIGIBLE- PARTICIPATING

SURGEON'S NAME: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

SURGEON'S SIGNATURE: _____

DATE: ☐☐ ☐☐ ☐☐☐☐

CHIEF COMPLAINTS:

DIMINUTION OF VISION RE ☐

Duration: _____ days/ months/years

LE ☐

Duration: _____ days/ months/years

HISTORY OF PRESENT ILLNESS:

1 .DIMINUTION OF VISION	1- Gradual; 2- Sudden	☐
	1- Progressive; 2- Static	☐
	1- Painless; 2- Painful	☐
	1- For distance 2- For near	☐
2. DIPLOPIA/POLYOPIA	1- Present; 2- Absent	☐
3. COLOURED HALOS	1- Present; 2- Absent	☐
4. BLACK SPOTS BEFORE THE EYES	1- Present; 2 - Absent	☐
5. WATERING	1- Present; 2 - Absent	☐
6. REDNESS	1- Present; 2 - Absent	☐
7. DISCHARGE	1- Present; 2 - Absent	☐
8. H/O WEARING GLASSES	(1-Distance; 2-Near; 3-Both)	☐
	Duration: ☐☐ months/years	

PAST HISTORY:

TRAUMA TO THE EYE: 1- Present 2- Absent ☐

OCULAR SURGERY: 1- Present 2- Absent ☐

Type of surgery: _____

Duration: ☐☐ months/years

DIABETES: 1- Present 2- Absent ☐

Duration: ☐☐ months/years

HYPERTENSION: 1- Present 2- Absent ☐

Duration: ☐☐ months/years

ANY OTHER MEDICAL DISORDERS: _____

PERSONAL HISTORY:

SMOKING: 1- Present; 2- Absent ☐

Duration: ☐☐ months/years

ALCOHOLISM: 1- Present; 2- Absent ☐

Duration: ☐☐ months/years

ANY OTHER ADDICTIONS: _____ ☐

Duration: ☐☐ months/years

GENERAL PHYSICAL EXAMINATION:

General Appearance:

1- Well built, 2- Moderately built, 3- Poorly built, 4- emaciated ☐

Pallor: 1- Present 2- Absent ☐

If present 1- Mild 2- Moderate 3- Severe ☐

Pulse: ☐☐☐/minute

BP: -☐☐☐ /☐☐☐ mm of hg

Temperature: ☐☐☐ degree Fahrenheit

Respiratory rate: ☐☐ minute

SYSTEMIC EXAMINATION:

CVS: 1- Normal 2- Abnormal ☐

if 2, specify: _____

RS: 1- Normal 2- Abnormal
if 2, specify: _____ ☐

CNS: 1- Normal 2- Abnormal
if 2, specify: _____ ☐

Per Abdomen: 1- Normal 2- Abnormal
if 2, specify: _____ ☐

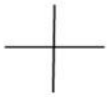
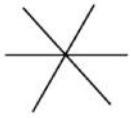
OCULAR EXAMINATION:

Head posture: 1- Erect, 2- Tilted ☐

Visual Axis: 1- Parallel, 2- Deviated ☐

Facial Symmetry: 1- Symmetrical, 2- Asymmetrical ☐

Extraocular movements:

RE:-  Binocular:-  LE:- 

(N- Normal, R- Restricted) ☐

1) Visual Acuity:

	RE	LE
DISTANT		
PINHOLE		
NEAR		
AIDED		

REFRACTION/RETINOSCOPY:

Prescription	Spherical	Cylindrical	Axis	BCVA
RE				
LE				

2. Adnexa (1- Normal; 2-Abnormal)	☐	☐
3. Sclera (1- Normal; 2- Congested)	☐	☐

4. Conjunctiva (1-normal; 2-conjunctival congestion; 3-ciliary congestion; 4-chemosis)	☐	☐
5. Cornea (1- normal; 2-opacity; 3-vascularisation)	☐	☐
6. Anterior chamber (1- normal depth; 2-shallow; 3-deep)	☐	☐
7. Iris (1-normal colour & pattern; 2-Abnormal)	☐	☐

8. Pupil: Size- ____ in mm Shape- 1- Round & Regular; 2-Abnormal Reaction: Direct (1. Present, 2. Absent) Indirect (1. Present, 2. Absent) Near reflex (1. Present, 2. Absent)		☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
9. Lens Clarity- 1. Clear, 2. Opaque Cataract - (1) , PCIOL - (2) Cataract if present- 1.immature 2.mature 3. hyper mature		☐ ☐ ☐	☐ ☐ ☐
A) CORTICAL CATARACT- (1.Present, 2. Absent) If Present - C1 to C5. (as per LOCS III classification)		☐ ☐	☐ ☐
B) NUCLEAR SCLEROSIS- 1. PRESENT, 2- ABSENT If present- NS1 to NS6 (as per LOCS III classification)		☐ ☐	☐ ☐
(C) POSTERIOR SUBCAPSULAR CATARACT 1. PRESENT, 2. ABSENT If present - P1 to P5 (as per LOCS III classification)		☐ ☐	☐ ☐

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

DIAGNOSIS:-

IMPRESSION:-

INVESTIGATIONS:

A) Lacrimal patency

(1-Patent; 2- Regurgitation: 2A- Clear fluid, 2B- Mucopurulent; 3-Blocked/Not-Patent)

RE ☐

LE ☐

B) IOP:

RE: ☐ mm of hg

LE: ☐ mm of hg

C) Blood sugar: _____mg%

D) Blood Pressure: _____mm of hg

PREOPERATIVE KERATOMETRY:

EYE: ☐ (1-Right eye; 2- Left eye)

KH (Diopters)	Axis (degree)	KV (Diopters)	Axis (degree)	Preoperative astigmatism(A) A= KH-KV	Axis (degree)

A SCAN BIOMETRY: (SRK II FORMULA)

KH	
KV	
AXL	
AC DEPTH	
PCIOL	

OPERATIVE PROCEDURE: 1. SICS 2. PHACO ☐

DATE: _____/_____/_____

OPERATING EYE: _____

ANAESTHESIA: PERIBULBAR BLOCK ☐

TOPICAL ☐

INCISION: 1. Superior ☐

2. Temporal ☐

3. Superior temporal ☐

4. Inferior temporal ☐

INTRAOCULAR LENS TYPE: _____

Intra-Operative Complications: 1. Present, 2. Absent ☐

If present- specify

FOLLOW UP PLAN: **1 Day (post-operatively)**

1. Conjunctiva (1-normal; 2-conjunctival congestion; 3-ciliary congestion; 4-chemosis)	☐
2.Section/suture site (1-edges opposed; 2- edges gaping)	☐
3.Cornea (1-clear; 2-hazy/Descemet's folds)	☐
4. Anterior chamber (1- normal depth; 2-shallow; 3-deep)	☐
5. Pupil: Size- ____ in mm Shape- 1- Round & Regular; 2-Abnormal IF 2 (Specify) :	☐
6.Intraocular Lens (1-in situ, 2-decentred)	☐

VISUAL ACUITY	RE	LE
DISTANT		
PINHOLE		

KERATOMETRY:

EYE: ☐ (1-Right eye; 2- Left eye)

KH (Diopters)	Axis (degree)	KV (Diopters)	Axis (degree)	Postoperative astigmatism(A) A= KH-KV	Axis (degree)

FOLLOW UP PLAN: **1 Week (post-operatively)**

1. Conjunctiva (1-normal; 2-conjunctival congestion; 3-ciliary congestion; 4-chemosis)	☐
2.Section/suture site (1-edges opposed; 2- edges gaping)	☐
3.Cornea (1-clear; 2-hazy/Descemet's fold)	☐
4. Anterior chamber (1- normal depth; 2-shallow; 3-deep)	☐
5. Pupil: Size- ____ in mm Shape- 1- Round & Regular; 2-Abnormal IF 2(Specify) :	☐
6.Intraocular Lens (1-in situ, 2-decentred)	☐

VISUAL ACUITY	RE	LE
DISTANT		
PINHOLE		

KERATOMETRY:

EYE: ☐ (1-Right eye; 2- Left eye)

KH (Diopters)	Axis (degree)	KV (Diopters)	Axis (degree)	Postoperative astigmatism(A) A= KH-KV	Axis (degree)

FOLLOW UP PLAN: 6 Weeks (post-operatively)

1. Conjunctiva (1-normal; 2-conjunctival congestion; 3-ciliary congestion; 4-chemosis)	☐
2.Section/suture site (1-edges opposed; 2- edges gaping)	☐
3.Cornea (1-clear; 2-hazy/Descemet's folds)	☐
4. Anterior chamber (1- normal depth; 2-shallow; 3-deep)	☐
5. Pupil: Size- ____ in mm Shape- 1- Round & Regular; 2-Abnormal IF 2(Specify) :	☐
6.Intraocular Lens (1-in situ, 2-decentred)	☐

VISUAL ACUITY	RE	LE
DISTANT		
PINHOLE		

KERATOMETRY:

EYE: ☐ (1-Right eye; 2- Left eye)

KH (Diopters)	Axis (degree)	KV (Diopters)	Axis (degree)	Postoperative astigmatism(A) A= KH-KV	Axis (degree)

Prescription	Spherical	Cylindrical	Axis	BCVA
RE				
LE				

SURGICALLY INDUCED ASTIGMATISM:

SURGICALLY INDUCED ASTIGMATISM	Astigmatism in diopters (KH – KV)	AXIS in degrees
1 DAY		
1 WEEK		
6 WEEKS		

Serial No.	Name	IP NO	AGE	SEX	Eye																																									
						PRE-OPERATIVE										SURGERY	POST-OPERATIVE DAY 1										POST-OPERATIVE 1 WEEK										POST-OPERATIVE 6 WEEKS											
				Male/Female	Right/Left	UCVA	UCVA (in logMAR)	BCVA	BCVA (in logMAR)	Grade of NS	Kh(180)	Kv(90)	PCIOL (in Diopters)	Astigmatism	Meridian	Type		UCVA	UCVA (in logMAR)	BCVA	BCVA (in logMAR)	Kh(180)	Kv(90)	Astigmatism	Meridian	SIA AT 1 DAY POST-OP	Meridian	UCVA	UCVA (in logMAR)	BCVA	BCVA (in logMAR)	Kh(180)	Kv(90)	Astigmatism	Meridian	SIA AT 1 WEEK POST-OP	Meridian	UCVA	UCVA (in logMAR)	BCVA	BCVA (in logMAR)	Kh(180)	Kv(90)	Astigmatism	Meridian	SIA AFTER 6 WEEKS POST-OP	Meridian	TYPE OF ASTIGMATISM INDUCED
1	Subhash	783289	66	M	R	6/36	0.78	6/24	0.60	2	45.00	45.50	+21.00	0.50	90	WTR	P	6/9	0.18	6/6	0.00	45.00	45.25	0.25	90	0.25	90	6/9	0.18	6/6	0.00	45.25	44.75	0.50	180	1.00	90	6/9	0.18	6/6	0.00	45.50	44.75	0.75	180	1.25	180	ATR
2	Paravva	794648	75	F	L	1/60	1.78	2/60	1.48	3	45.25	44.00	+24.00	1.25	180	ATR	S	6/24	0.60	6/12	0.30	45.25	43.25	2.00	180	2.00	90	6/36	0.78	6/12	0.30	45.25	43.25	2.00	180	2.00	90	6/36	0.78	6/12	0.30	45.50	43.00	2.50	180	2.50	180	ATR
3	Sushila	798072	57	F	L	1/60	1.78	6/60	1.00	3	43.00	43.75	+18.00	0.75	90	WTR	P	6/6	0.00	6/6	0.00	43.00	43.00	0.00	0	0.75	90	6/12	0.30	6/9	0.18	43.00	42.75	0.25	180	1.00	90	6/9	0.18	6/6	0.00	43.50	43.25	0.25	180	1.00	180	ATR
4	Babu	799453	70	M	L	6/36	0.78	6/24	0.60	2	46.00	46.50	+18.50	0.50	90	WTR	S	6/12	0.30	6/6	0.00	46.50	44.50	2.00	180	2.50	90	6/18	0.48	6/6	0.00	47.00	44.50	2.50	180	3.00	90	6/12	0.30	6/6	0.00	46.50	44.50	2.00	180	2.50	180	ATR
5	Venkat	799452	72	M	L	2/60	1.48	6/36	0.78	3	40.00	40.50	+20.00	0.50	90	WTR	S	6/12	0.30	6/9	0.18	40.00	39.50	0.50	180	1.00	90	6/18	0.48	6/12	0.30	40.50	39.50	1.00	180	1.50	90	6/12	0.30	6/6	0.00	40.75	40.00	0.75	180	1.25	180	ATR
6	Razia	800799	51	F	R	2/60	1.48	2/60	1.48	3	46.00	45.75	+24.00	0.25	180	ATR	P	6/9	0.18	6/6	0.00	46.00	45.00	1.00	180	0.75	90	6/12	0.30	6/6	0.00	46.00	44.75	1.25	180	1.00	90	6/12	0.30	6/6	0.00	46.00	45.00	1.00	180	0.75	180	ATR
7	Ratnavva	800811	70	F	L	3/60	1.30	6/24	0.60	3	45.75	44.75	+20.00	1.00	180	ATR	P	6/18	0.48	6/12	0.30	45.75	44.50	1.25	180	0.25	90	6/18	0.48	6/9	0.18	45.50	44.25	1.25	180	0.25	90	6/12	0.30	6/6	0.00	45.50	44.00	1.50	180	0.50	180	ATR
8	Sushila B.	801672	55	F	L	1/60	1.78	1/60	1.78	2	43.25	42.50	+21.50	0.75	180	ATR	P	6/18	0.48	6/9	0.18	43.25	42.00	1.25	180	0.50	90	6/18	0.48	6/12	0.30	43.25	41.75	1.50	180	0.75	90	6/12	0.30	6/9	0.18	43.25	41.50	1.75	180	1.00	180	ATR
9	Kamalaxi	803055	58	F	R	1/60	1.78	6/60	1.00	2	45.50	45.00	+21.50	0.50	180	ATR	P	6/6	0.00	6/6	0.00	45.50	44.50	1.00	180	0.50	90	6/9	0.18	6/6	0.00	45.25	44.25	1.00	180	0.50	90	6/6	0.00	6/6	0.00	45.00	45.00	0.00	0	0.50	180	ATR
10	Shamrao	807994	60	M	R	1/60	1.78	1/60	1.78	3	46.00	46.50	+18.00	0.50	90	WTR	p	6/6	0.00	6/6	0.00	45.75	45.50	0.25	180	0.75	90	6/6	0.00	6/6	0.00	45.50	45.50	0.00	0	0.50	90	6/6	0.00	6/6	0.00	45.50	45.25	0.25	180	0.75	180	ATR
11	Gangubai	808530	55	F	L	2/60	1.48	6/36	0.78	2	45.00	45.50	+20.50	0.50	90	WTR	p	6/9	0.18	6/6	0.00	44.75	44.00	0.75	180	1.25	90	6/12	0.30	6/9	0.18	44.75	43.75	1.00	180	1.50	90	6/12	0.30	6/9	0.18	44.75	43.75	1.00	180	1.50	180	ATR
12	laxmavva	809515	70	F	R	1/60	1.78	6/18	0.48	2	49.50	49.00	+21.50	0.50	180	ATR	P	6/12	0.30	6/9	0.18	49.50	48.50	1.00	180	0.50	90	6/12	0.30	6/9	0.18	49.50	48.00	1.50	180	1.00	90	6/12	0.30	6/6	0.00	49.25	47.75	1.50	180	1.00	180	ATR
13	Chinnavva	809522	65	F	L	1/60	1.78	3/60	1.30	3	45.00	44.50	+20.50	0.50	180	ATR	p	6/9	0.18	6/6	0.00	45.00	44.25	0.75	180	0.25	90	6/12	0.30	6/6	0.00	44.75	44.00	0.75	180	0.25	90	6/9	0.18	6/6	0.00	45.00	44.00	1.00	180	0.50	180	ATR
14	Gouravva	809503	70	F	R	2/60	1.48	6/60	1.00	3	44.50	44.00	+21.00	0.50	180	ATR	P	6/9	0.18	6/9	0.18	44.50	43.00	1.50	180	1.00	90	6/12	0.30	6/6	0.00	44.50	43.50	1.00	180	0.50	90	6/9	0.18	6/6	0.00	44.50	43.50	1.00	180	0.50	180	ATR
15	Chandravva	820493	60	F	R	6/36	0.78	6/18	0.48	2	46.50	45.50	+20.00	1.00	180	ATR	S	6/12	0.30	6/12	0.30	47.00	44.50	2.50	180	1.50	90	6/18	0.48	6/9	0.18	47.00	45.00	2.00	180	1.00	90	6/12	0.30	6/9	0.18	46.50	44.50	2.00	180	1.00	180	ATR
16	Bhimappa	822883	66	M	R	3/60	1.30	6/60	1.00	3	43.50	44.25	+20.50	0.75	90	WTR	P	6/18	0.48	6/9	0.18	43.75	44.00	0.25	90	0.50	90	6/18	0.48	6/12	0.30	43.75	43.75	0.00	0	0.75	90	6/18	0.48	6/9	0.18	43.75	43.50	0.25	180	1.00	180	ATR
17	Chandravva	822865	68	F	L	1/60	1.78	3/60	1.30	3	45.50	44.50	+20.50	1.00	180	ATR	P	6/36	0.78	6/18	0.48	45.25	43.75	1.50	180	0.50	90	6/18	0.48	6/9	0.18	45.25	44.00	1.25	180	0.25	90	6/18	0.48	6/6	0.00	45.50	44.00	1.50	180	0.50	180	ATR
18	Abibi	822842	65	F	R	6/18	0.48	6/12	0.30	2	46.00	47.00	+19.50	1.00	90	WTR	P	6/9	0.18	6/6	0.00	46.00	46.25	0.25	90	0.75	90	6/12	0.30	6/6	0.00	46.00	46.00	0.00	0	1.00	90	6/12	0.30	6/6	0.00	45.75	46.00	0.25	90	0.75	180	ATR
19	Gouravva	823129	60	F	R	1/60	1.78	6/60	1.00	3	43.75	44.25	+20.50	0.50	90	WTR	P	6/12	0.30	6/9	0.18	43.50	44.00	0.50	90	0.00	90	6/9	0.18	6/6	0.00	43.75	44.00	0.25	90	0.25	90	6/6	0.00	6/6	0.00	44.00	44.00	0.00	0	0.50	180	ATR
20	Maruti	823542	71	M	R	6/60	1.00	6/36	0.78	2	41.50	43.00	+20.50	1.50	90	WTR	P	6/18	0.48	6/6	0.00	41.50	42.50	1.00	90	0.50	90	6/18	0.48	6/9	0.18	41.50	42.25	0.75	90	0.75	90	6/18	0.48	6/6	0.00	41.50	42.00	0.50	90	1.00	180	ATR
21	Vijay	824174	52	M	L	6/60	1.00	6/24	0.60	3	43.00	43.50	+20.50	0.50	90	WTR	P	6/12	0.30	6/6	0.00	42.75	42.75	0.00	0	0.50	90	6/9	0.18	6/6	0.00	42.75	42.50	0.25	180	0.75	90	6/9	0.18	6/6	0.00	43.00	42.25	0.75	180	1.25	180	ATR
22	Shantavva H.	825417	58	F	R	3/60	1.30	6/18	0.48	2	44.50	44.50	+23.00	0.00	0		P	6/24	0.60	6/9	0.18	44.25	44.00	0.25	180	0.25	90	6/9	0.18	6/9	0.18	44.25	43.75	0.50	180	0.50	90	6/9	0.18	6/6	0.00	44.25	43.50	0.75	180	0.75	180	ATR
23	Shantavva K.	828869	82	F	R	6/60	1.00	6/24	0.60	2	48.25	47.00	+19.50	1.25	180	ATR	P	6/36	0.78	6/12	0.30	48.00	46.50	1.50	180	0.25	90	6/18	0.48	6/9	0.18	48.25	46.75	1.50	180	0.25	90	6/18	0.48	6/6	0.00	48.00	46.25	1.75	180	0.50	180	ATR
24	Rudrappa	844452	69	M	L	2/60	1.48	6/36	0.78	3	41.50	42.00	+20.00	0.50	90	WTR	P	6/6	0.00	6/6	0.00	41.50	41.50	0.00	0	0.50	90	6/6	0.00	6/6	0.00	41.50	41.25	0.25	180	0.75	90	6/9	0.18	6/6	0.00	41.50	41.00	0.50	180	1.00	180	ATR
25	Chayabai	844456	55	F	L	2/60	1.48	6/24	0.60	3	43.50	43.50	+20.50	0.00	0		P	6/12	0.30	6/9	0.18	43.75	43.50	0.25	180	0.25	90	6/9	0.18	6/6	0.00	43.75	43.00	0.75	180	0.75	90	6/9	0.18	6/6	0.00	43.50	42.75	0.75	180	0.75	180	ATR
26	Gangavva	845484	65	F	R	3/60	1.30	6/36	0.78	3	46.25	45.25	+24.00	1.00	180	ATR	P	6/36	0.78	6/18	0.48	46.00	44.75	1.25	180	0.25	90	6/12	0.30	6/9	0.18	46.25	44.50	1.75	180	0.75	90	6/12	0.30	6/9	0.18	46.00	44.50	1.50	180	0.50	180	ATR
27	Basamma	855170	70	F	R	6/24	0.60	6/18	0.48	2	44.00	47.50	+19.50	3.50	90	WTR	S	6/18	0.48	6/12	0.30	44.00	46.50	2.50	90	1.00	90	6/18	0.48	6/9	0.18	44.50	46.00	1.50	90	2.00	90	6/12	0.30	6/9	0.18	44.75	45.75	1.00	90	2.50	180	ATR
28	Mallavva	854131	78	F	R	6/18	0.48	6/18	0.48	2	44.75	44.50	+19.00	0.25	180	ATR	S	6/9	0.18	6/9	0.18	45.25	44.00	1.25	180	1.00	90	6/12	0.30	6/9	0.18	45.00	43.50	1.50	180	1.25	90	6/12	0.30	6/9	0.18	45.00	43.00	2.00	180	1.75	180	ATR
29	Sushila T.	859171	55	F	L	6/36	0.78	6/24	0.60	2	44.00	45.50	+21.00	1.50	90	WTR	S	6/12	0.30	6/9	0.18	44.00	44.50	0.50	90	1.00	90	6/9	0.18	6/6	0.00	44.25	44.50	0.25	90	1.25	90	6/6	0.00	6/6	0.00	44.00	44.00	0.00	0	1.50	180	ATR
30	hivshankarepp	863521	45	M	R	1/60	1.78	6/60	1.00	3	45.25	47.25	+18.00	2.00	90	WTR	S	6/18	0.48	6/12	0.30	45.50	46.00	0.50	90	1.50	90	6/12	0.30	6/9	0.18	45.50	45.50	0.00	0	2.00	90	6/12	0.30	6/6	0.00	45.50	45.25	0.25	180	2.25	180	ATR
31	Shankareppa	863491	72	M	L	2/60	1.48	6/60	1.00	3	45.00	46.00	+21.00	1.00	90	WTR	S	6/18	0.48	6/12	0.30	45.50	45.00	0.50	180	1.50	90	6/18	0.48	6/9	0.18	45.00	44.50	0.50	180	1.50	90	6/12	0.30	6/9	0.18	45.00	44.00	1.00	180	2.00	180	ATR
32	Ratnabai	865799	60	F	R	3/60	1.30	6/60	1.00	3	45.00	44.00	+21.00	1.00	180	ATR	S	6/24	0.60	6/18	0.48	45.25	42.25	3.00	180	2.00	90	6/12	0.30	6/9	0.18	45.00	42.25	2.75	180	1.75	90	6/18	0.48	6/9	0.18	45.00	42.00	3.00	180	2.00	180	ATR
33	Modinsab	863529	70	M	R	6/36	0.78	6/24	0.60	2	44.25	45.75	+21.50	1.50	90	WTR	S	6/12	0.30	6/6	0.00	44.50	44.00	0.50	180	2.00	90	6/12	0.30	6/6	0.00	44.50	43.50	1.00	180	2.50	90	6/18	0.48	6/9	0.18	44.25	43.00	1.25	180	2.75	180	ATR

Serial No.	Name	IP NO	AGE	SEX	Eye	PRE-OPERATIVE											SURGERY	POST-OPERATIVE DAY 1								SIA AT 1 DAY POST-OP	Meridian	POST-OPERATIVE 1 WEEK								SIA AT 1 WEEK POST-OP	Meridian	POST-OPERATIVE 6 WEEKS								SIA AFTER 6 WEEKS POST-OP	Meridian	TYPE OF ASTIGMATISM INDUCED
						UCVA	UCVA (in logMAR)	BCVA	BCVA (in logMAR)	Grade of NS	Kh(180)	Kv(90)	PCIOL (in Diopters)	Astigmatism	Meridian	Type		UCVA	UCVA (in logMAR)	BCVA	BCVA (in logMAR)	Kh(180)	Kv(90)	Astigmatism	Meridian			UCVA	UCVA (in logMAR)	BCVA	BCVA (in logMAR)	Kh(180)	Kv(90)	Astigmatism	Meridian			UCVA	UCVA (in logMAR)	BCVA	BCVA (in logMAR)	Kh(180)	Kv(90)	Astigmatism	Meridian				
34	Manohar	865677	64	M	L	6/24	0.60	6/12	0.30	2	42.50	43.25	+20.00	0.75	90	WTR	P	6/18	0.48	6/9	0.18	42.25	42.75	0.50	90	0.25	90	6/12	0.30	6/9	0.18	42.50	42.50	0.25	90	0.75	90	6/9	0.18	6/6	0.00	42.50	42.50	0.00	0	0.75	180	ATR
35	Babu Patil	867580	70	M	R	1/60	1.78	6/60	1.00	3	43.50	43.50	+24.00	0.00	0		S	6/24	0.60	6/12	0.30	43.75	42.50	1.25	180	1.25	90	6/18	0.48	6/9	0.18	43.50	42.25	1.25	180	1.25	90	6/18	0.48	6/9	0.18	43.75	42.00	1.75	180	1.75	180	ATR
36	Ramchandra	863480	66	M	L	6/24	0.60	6/18	0.48	2	41.75	42.25	+21.50	0.50	90	WTR	P	6/18	0.48	6/12	0.30	42.00	41.75	0.25	180	0.75	90	6/18	0.48	6/6	0.00	41.75	41.50	0.25	180	0.75	90	6/12	0.30	6/6	0.00	41.75	41.25	0.50	180	1.00	180	ATR
37	Anand	866639	70	M	L	6/60	1.00	6/24	0.60	3	43.25	44.50	+22.00	1.25	90	WTR	S	6/18	0.48	6/12	0.30	43.25	43.25	0.00	0	1.25	90	6/12	0.30	6/9	0.18	43.25	43.00	0.25	180	1.50	90	6/9	0.18	6/6	0.00	43.25	42.75	0.50	180	1.75	180	ATR
38	Guruling	865852	60	M	R	3/60	1.30	6/24	0.60	3	43.50	43.50	+21.50	0.00	0		S	6/18	0.48	6/12	0.30	43.50	42.00	1.50	180	1.50	90	6/18	0.48	6/12	0.30	43.50	41.50	2.00	180	2.00	90	6/18	0.48	6/9	0.18	43.75	41.25	2.50	180	2.50	180	ATR
39	Pundalik	856886	68	M	R	1/60	1.78	3/60	1.30	3	43.50	43.25	+20.50	0.25	180	ATR	P	6/12	0.30	6/9	0.18	43.75	43.00	0.75	180	0.50	90	6/12	0.30	6/9	0.18	43.50	43.00	0.50	180	0.25	90	6/18	0.48	6/9	0.18	43.50	42.50	1.00	180	0.75	180	ATR
40	Ramappa	859170	60	M	L	3/60	1.30	6/60	1.00	2	45.00	45.25	+20.00	0.25	90	WTR	S	6/9	0.18	6/6	0.00	45.25	44.00	1.25	180	1.50	90	6/12	0.30	6/6	0.00	45.25	43.50	1.75	180	2.00	90	6/12	0.30	6/6	0.00	45.25	43.75	1.50	180	1.75	180	ATR
41	Monappa	862132	61	M	L	1/60	1.78	6/60	1.00	2	44.25	43.50	+21.00	0.75	180	ATR	S	6/9	0.18	6/9	0.18	44.50	42.50	2.00	180	1.25	90	6/12	0.30	6/9	0.18	44.50	42.00	2.50	180	1.75	90	6/18	0.48	6/6	0.00	44.50	41.50	3.00	180	2.25	180	ATR
42	Shivamoggi	862112	72	M	L	6/36	0.78	6/18	0.48	3	45.25	46.00	+21.00	0.75	90	WTR	P	6/12	0.30	6/6	0.00	45.25	45.00	0.25	180	1.00	90	6/12	0.30	6/6	0.00	45.25	44.75	0.50	180	1.25	90	6/18	0.48	6/9	0.18	45.25	44.50	0.75	180	1.50	180	ATR
43	Shantavva H.	863637	66	F	L	1/60	1.78	2/60	1.48	3	46.25	49.00	+18.50	2.75	90	WTR	S	6/18	0.48	6/9	0.18	46.50	47.50	1.00	90	1.75	90	6/12	0.30	6/9	0.18	46.50	47.00	0.50	90	2.25	90	6/12	0.30	6/9	0.18	46.50	47.00	0.50	90	2.25	180	ATR
44	Annapurna	860390	47	F	L	1/60	1.78	3/60	1.30	3	46.00	47.50	+21.50	1.50	90	WTR	S	6/18	0.48	6/12	0.30	46.00	46.50	0.50	90	1.00	90	6/12	0.30	6/6	0.00	46.00	46.50	0.50	90	1.00	90	6/6	0.00	6/6	0.00	45.75	46.00	0.25	90	1.25	180	ATR
45	Savita Gurav	855676	45	F	R	1/60	1.78	3/60	1.30	3	43.25	42.25	+20.50	1.00	180	ATR	S	6/12	0.30	6/9	0.18	43.50	41.75	1.75	180	0.75	90	6/9	0.18	6/6	0.00	43.50	41.75	1.75	180	0.75	90	6/12	0.30	6/6	0.00	43.50	41.50	2.00	180	1.00	180	ATR
46	Sujata	858019	50	F	R	6/36	0.78	6/18	0.48	2	43.50	43.25	+22.00	0.25	180	ATR	S	6/9	0.18	6/6	0.00	43.50	42.25	1.25	180	1.00	90	6/12	0.30	6/6	0.00	43.75	42.25	1.50	180	1.25	90	6/9	0.18	6/6	0.00	43.50	42.00	1.50	180	1.25	180	ATR
47	Mahadevi	862985	59	F	R	6/60	1.00	6/36	0.78	3	43.50	44.00	+19.50	0.50	90	WTR	S	6/12	0.30	6/9	0.18	44.00	43.00	1.00	180	1.50	90	6/18	0.48	6/12	0.30	43.75	42.50	1.25	180	1.75	90	6/12	0.30	6/6	0.00	43.75	42.25	1.50	180	2.00	180	ATR
48	Lakkavva	857341	73	F	R	6/36	0.78	6/18	0.48	3	44.25	45.50	+21.50	1.25	90	WTR	S	6/12	0.30	6/9	0.18	44.50	44.00	0.50	180	1.75	90	6/12	0.30	6/6	0.00	44.75	43.75	1.00	180	2.25	90	6/18	0.48	6/9	0.18	44.75	43.50	1.25	180	2.50	180	ATR
49	Gurusiddappa	851874	66	M	L	6/60	1.00	6/24	0.60	2	42.75	43.50	+20.00	0.75	90	WTR	P	6/18	0.48	6/9	0.18	42.50	43.00	0.50	90	0.25	90	6/12	0.30	6/9	0.18	42.50	42.75	0.25	90	0.50	90	6/9	0.18	6/6	0.00	42.50	42.50	0.00	0	0.75	180	ATR
50	Shivappa	852401	74	M	L	3/60	1.30	6/60	1.00	3	45.25	46.25	+21.00	1.00	90	WTR	S	6/24	0.60	6/12	0.30	45.50	45.00	0.50	180	1.50	90	6/18	0.48	6/9	0.18	45.00	44.50	0.50	180	1.50	90	6/12	0.30	6/9	0.18	45.00	44.00	1.00	180	2.00	180	ATR
51	Ravi	852684	67	M	R	6/60	1.00	6/36	0.78	2	43.75	44.50	+20.50	0.75	90	WTR	P	6/18	0.48	6/9	0.18	43.75	44.00	0.25	90	0.50	90	6/18	0.48	6/12	0.30	43.75	43.75	0.00	0	0.75	90	6/12	0.30	6/6	0.00	43.75	43.50	0.25	180	1.00	180	ATR
52	Sulochana	862960	53	F	R	1/60	1.78	3/60	1.30	3	45.25	44.75	+21.50	0.50	180	ATR	P	6/9	0.18	6/6	0.00	45.25	44.25	1.00	180	0.50	90	6/9	0.18	6/6	0.00	45.25	44.25	1.00	180	0.50	90	6/9	0.18	6/6	0.00	45.00	44.00	1.00	180	0.50	180	ATR
53	Manjula	866813	55	F	L	6/60	1.00	6/18	0.48	2	42.75	43.25	+20.50	0.50	90	WTR	P	6/12	0.30	6/6	0.00	42.75	42.75	0.00	0	0.50	90	6/9	0.18	6/6	0.00	42.75	42.50	0.25	180	0.75	90	6/9	0.18	6/6	0.00	43.00	42.25	0.75	180	1.25	180	ATR
54	Narayan	864184	61	M	R	6/36	0.78	6/18	0.48	3	44.25	47.75	+19.50	3.50	90	WTR	S	6/18	0.48	6/9	0.18	44.25	46.75	2.50	90	1.00	90	6/18	0.48	6/9	0.18	44.50	46.00	1.50	90	2.00	90	6/12	0.30	6/9	0.18	44.25	45.50	1.25	90	2.25	180	ATR
55	Yallappa	869549	58	M	R	6/24	0.60	6/12	0.30	2	46.00	47.00	+19.50	1.00	90	WTR	S	6/9	0.18	6/6	0.00	46.00	46.25	0.25	90	0.75	90	6/12	0.30	6/6	0.00	46.00	46.00	0.00	0	1.00	90	6/12	0.30	6/6	0.00	46.00	45.75	0.25	180	1.25	180	ATR
56	Anusuya	861573	59	F	L	6/60	1.00	6/12	0.30	2	43.25	43.75	+20.50	0.50	90	WTR	S	6/12	0.30	6/6	0.00	43.25	42.75	0.50	180	1.00	90	6/9	0.18	6/6	0.00	43.25	42.50	0.75	180	1.25	90	6/9	0.18	6/6	0.00	43.00	42.25	0.75	180	1.25	180	ATR
57	Devamma	864019	70	F	L	1/60	1.78	6/60	1.00	3	44.75	44.25	+20.50	0.50	180	ATR	S	6/9	0.18	6/6	0.00	45.00	43.75	1.25	180	0.75	90	6/12	0.30	6/6	0.00	45.00	43.50	1.50	180	1.00	90	6/12	0.30	6/6	0.00	45.00	43.25	1.75	180	1.25	180	ATR
58	Parappa	865810	55	M	R	2/60	1.48	3/60	1.30	3	45.75	45.50	+24.00	0.25	180	ATR	S	6/9	0.18	6/6	0.00	46.00	44.00	2.00	180	1.75	90	6/12	0.30	6/6	0.00	46.00	43.75	2.25	180	2.00	90	6/12	0.30	6/6	0.00	46.00	43.50	2.50	180	2.25	180	ATR
59	Shankar	877585	64	M	R	1/60	1.78	6/36	0.78	3	46.00	45.00	+24.00	1.00	180	ATR	S	6/18	0.48	6/12	0.30	46.00	44.00	2.00	180	1.00	90	6/18	0.48	6/9	0.18	46.25	44.00	2.25	180	1.25	90	6/18	0.48	6/9	0.18	46.00	43.75	2.25	180	1.25	180	ATR
60	Savitri	877893	69	F	L	6/60	1.00	6/24	0.60	2	46.50	49.25	+18.50	2.75	90	WTR	S	6/18	0.48	6/9	0.18	46.75	47.75	1.00	90	1.75	90	6/12	0.30	6/9	0.18	46.50	47.25	0.75	90	2.00	90	6/12	0.30	6/9	0.18	46.50	47.00	0.50	90	2.25	180	ATR

"COMPARATIVE STUDY OF SURGICALLY INDUCED ASTIGMATISM AND POST-OPERATIVE VISUAL ACUITY IN SMALL INCISION CATARACT SURGERY AND PHACOEMULSIFICATION – A ONE YEAR RANDOMIZED TRIAL AT KLES DR. PRABHAKAR KORE HOSPITAL AND MEDICAL RESEARCH CENTRE, BELAGAVI."

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This is to certify that the dissertation entitled **"COMPARATIVE STUDY OF SURGICALLY INDUCEDASTIGMATISM AND POST-OPERATIVE VISUAL ACUITY IN SMALL INCISION CATARACT SURGERY AND PHACOEMULSIFICATION – A ONE YEAR RANDOMIZED TRIAL AT KLES DR. PRABHAKAR KORE HOSPITAL AND MEDICAL RESEARCH CENTRE, BELAGAVI."** is a bonafide research work done by **REGISTRATION NO.BK0116001**

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LIST OF ABBREVIATIONS USED

SL No.	ABBREVIATIONS	LONG FORM
1	ECCE	Extra Capsular Cataract Extraction
2	SICS	Small Incision Cataract Surgery
3	IOL	Intraocular Lens
4	SIA	Surgically Induced Astigmatism
5	FLACS	Femtosecond Laser Assisted Cataract Surgery.
6	BC	Before Christ
7	ICCE	Intra Capsular Cataract Extraction.
8	MSICS	Manual Small Incision Cataract Surgery.
9	CCC	Continuous Curvilinear Capsulorhexis
10	G	Gauge
11	D	Dioptres
12	WTR	With The Rule
13	ATR	Against The Rule.
14	UCVA	Uncorrected Visual Acuity
15	SRK	Sanders, Retzlaff and Kraff.
16	AC	Anterior Chamber
17	PRE-OP	Pre-Operative
18	POST-OP	Post-Operative
19	Kh	Keratometry at Horizontal meridian
20	Kv	Keratometry at Vertical meridian
21	BCVA	Best Corrected Visual Acuity
22	NC	Nuclear Opalescence

ABSTRACT

BACKGROUND AND OBJECTIVES

Cataract is the leading cause of avoidable blindness in India and is responsible for upto 50-80 percent cases of bilateral blindness. The history of cataract surgery starts from around 20 centuries ago, when Indian surgeon Susruta performed couching treat cataracts by dislodging the cataractous lens away from pupillary area. The surgeries have developed since then and the two most common techniques used nowadays for cataract extraction are small incision cataract surgery (SICS) and phacoemulsification.

Phacoemulsification, is the surgery of choice in developed countries whereas Small Incision Cataract Surgery is the most commonly performed cataract surgery in developing nations. The reason for this is high costs involved in setting up and doing a Phacoemulsification surgery which requires a Phacoemulsifier machine compared to Small Incision Cataract Surgery which is manual and is therefore much economical.

Patients who undergo cataract surgeries want less dependence on spectacles. Thus surprises in refractive errors after cataract surgery have become unacceptable in recent few years. As a result, cataract surgery has become refractive surgery offering improvements both in “best corrected” and “uncorrected” visual acuity. Presence of astigmatism after cataract surgery can cause blurred images and glare. This astigmatism can be residual or surgically induced. Surgically induced astigmatism (SIA) calculates the magnitude and axis of postoperative induced astigmatism.

Postoperative astigmatism is affected by various factors such as preoperative astigmatism, location, type, size, closure, and healing of the surgical incision, amount of scleral cauterization performed, type of suturing material used and its placement,

position of IOL, and postoperative use of steroids, and all these have effects on corneal curvature.

Control of surgically induced astigmatism has become a clinical efficacy benchmark when evaluating cataract surgical outcomes.

Therefore it is important to find the effective method of cataract surgery (phacoemulsification or manual small incision cataract surgery) which induces the least or no astigmatism post surgically and gives better visual outcome.

This study will compare the surgically induced astigmatism and post-operative visual acuity of two groups of patients who have undergone phacoemulsification and small incision cataract surgery. Thus the objectives of this study are:

1. To compare the surgically induced astigmatism in Small Incision Cataract Surgery (SICS) and Phacoemulsification.
2. To compare the Post-Operative Uncorrected and Best Corrected Visual acuity in SICS and Phacoemulsification.

MATERIALS AND METHODS.

This study, A one year randomized trial, was conducted at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre on patient with age related cataracts who attended the ophthalmology OPD in the hospital from 1 January 2017 to 31 December 2017. Patients with age related cataracts without any other ocular pathology were selected and divided randomly into two groups, one who underwent Phacoemulsification and one who underwent SICS. Phacoemulsification was done using divide and conquer technique through a 3.2 mm superior limbal incision and SICS was done using a 6 mm superior scleral incision. All the patients were evaluated at 1 day, 1 week and 6 weeks post-operatively.

RESULTS

The mean age of patients who underwent phacoemulsification was 63.20 years and those who underwent SICS was 63.26 years. 55% of all patients were females as compared to 45% males. 32 patients underwent cataract surgery in the right eye and 28 in the left eye. The mean pre-operative uncorrected visual acuity in phaco group was 1.32 logMAR while that in SICS group was 1.23 logMAR. The mean pre-operative best corrected visual acuity in PHACO group was 0.86 logMAR and in SICS group was 0.81 logMAR. All the patients had Nuclear Opalescence grade 2 or grade 3.

The patients who underwent phacoemulsification had mean uncorrected visual acuity as 0.35, 0.30 and 0.27 logMAR at 1 day, 1 week, and 6 weeks post-operative respectively while those who underwent SICS had a mean visual acuity of 0.38, 0.38 and 0.33 logMAR at 1 day, 1 week, and 6 weeks post-operative respectively. Using unpaired t-test, it was found that the difference of mean UCVA at 1 week was significant ($p<0.05$), while at follow-ups done at 1 day post-op and 6 weeks post-op, it was not significant.

Best corrected visual acuity in patients who underwent Phacoemulsification was 0.14, 0.11 and 0.04 logMAR at 1 day, 1 week and 6 weeks post-operative respectively. Those who underwent SICS had a mean best corrected visual acuity of 0.19, 0.13 and 0.10 logMAR respectively. The difference of best corrected visual acuity at 6 weeks post-operative follow-up was statistically significant ($p<0.05$).

The astigmatism induced in both the groups was against the rule (ATR). The mean surgically induced astigmatism in Phaco group was 0.84 D, while that in SICS group was 1.87 D. The difference of the astigmatism induced among the two groups was statistically significant ($p<0.000$).

The SIA in patients with pre-operative with the rule (WTR) astigmatism in PHACO group at follow-ups done on 1 day, 1 week and 6 weeks post-operatively was 0.56 D, 0.81 D and 1.02 D respectively and in those with pre-operative against the rule (ATR) astigmatism at follow-ups done on 1 day, 1 week and 6 weeks post-operatively was 0.48 D, 0.52 D and 0.63 respectively. In SICS group with pre-operative WTR astigmatism, the SIA at follow-ups done on 1 day, 1 week and 6 weeks post-operatively was 1.40 D, 1.79 D and 1.96 D respectively and in those with pre-operative ATR astigmatism at follow-ups done on 1 day, 1 week and 6 weeks post-operatively was 1.30 D, 1.40 D and 1.65 D respectively. The difference of SIA in PHACO group between patients with pre-operative WTR and ATR astigmatism was statistically significant at 1 week ($p=0.015$) and 6 weeks ($p=0.000$) post-operatively, while that in SICS group was not statistically significant. Thus the SIA in patients with pre-operative WTR astigmatism was higher than in those with pre-operative ATR astigmatism in both the study groups.

CONCLUSION AND INTERPRETATION

Phacoemulsification induces lesser astigmatism than SICS when incisions are made in the same meridian. The best corrected visual acuity at 6 weeks in phacoemulsification was significantly higher than that of SICS ($p<0.05$).

Thus we concluded that Phacoemulsification gives better visual outcome than SICS with minimal astigmatism.

Small incision cataract surgery was safe and was nearly as effective as phacoemulsification in terms of visual outcome to the patient. Even though it induced higher astigmatism than Phacoemulsification it provided patients with good vision after cataract surgery.

Key words: Cataract Surgery, PHACO, SICS, Surgically Induced Astigmatism.

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