

## Challenges of Cataract Surgery in One-eyed Individuals –Visual and Ocular Outcomes: A Single Surgeon Experience

<sup>1</sup>Dr Pawan G Kumar, <sup>2</sup>Dr V S Gurunadh, <sup>3</sup>Dr Mansur Ali Khan, <sup>4</sup>Dr Sridhar Reddy\*

<sup>1</sup>Asst Professor, <sup>2,3</sup>Professor, <sup>4</sup>Associate Professor

<sup>1,3,4</sup>Dept of Ophthalmology Command Hospital Air Force Bangalore

<sup>2</sup>Dept of Ophthalmology GSL Medical College, Rajahmundry AP

**\*Corresponding Author:**

**Dr Sridhar Reddy**

Associate Professor, Dept of Ophthalmology Command Hospital Air Force Bangalore

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

### ABSTRACT

**Introduction:** Forty one-eyed patients with significant operable cataracts in the good eye with well controlled systemic comorbidities underwent phaco emulsification by a single ophthalmologist in a secondary care hospital over duration of 4 years.

**Methodology:** Patients underwent preoperative systemic examination, investigations and comprehensive ocular evaluation which included SLE, IDO, GAT, TBUT, sac syringing, biometry, specular microscopy for endothelial cell counts, pachymetry, OCT and conjunctival swab cultures. Post phaco emulsification and PCIOL implantation, they were assessed on post op day 1, 7, 28 and 42. The visual outcomes measured were post-operative BCVA, endothelial cell count loss, peribulbar IOP changes, pre and post-operative keratometric astigmatism changes.

**Results:** The causes for blindness in fellow eyes in this study were corneal leucoma opacity 32.5%, complicated cataract surgery 17.5%, phthisis bulbi 15%, corneo-iridic scar 15%, retinal macular scar 12.5%, traumatic optic neuropathy 12.5% and retinal detachment 10%. The visual results in this cohort of one-eyed patients were good i.e., between 6/6 and 6/18. The mean pre-op visual LogMAR acuity was 0.8(0.18) and the mean post-op improvement in visual LogMAR acuity was 0.16(0.14). The mean endothelial cell loss as measured on day 42 postop was 229.62 cells/mm<sup>2</sup> (12%). The mean difference in the pre- and post-op pachymetry was 8.8 microns (2.67) at the end of 6 weeks. The average pressure rise due to the 7 ml of peribulbar block was noted to be 6.78 mm Hg (2.12) in our study. Surgically induced astigmatism at the end of 6 weeks was noted to be 13% WTR, 57% ATR and 30% Oblique.

**Keywords:** Cataract, Endothelial cell counts, One-eyed Patients, Peribulbar IOP

### INTRODUCTION

Cataract surgery is one of the most commonly performed surgeries in the world. One-eyed patients with cataract in their only good eye present a special challenge due to the precious nature of it being the only Seeing Eye. The fear of surgical complications and loss of vision is the paramount apprehension of both the patient and the surgeon.

One-eyed patients are defined as patients who have one eye removed or if retained have a vision less than 10/400 or 6/240 with non-remedial defects. <sup>(1)</sup>

The NPCB and WHO defines blindness with a BCVA of less than 3/60 in the better eye or a visual field less than 10 degrees around a central fixation. <sup>(2)</sup>

The causes of blindness in the affected eye of one-eyed patients are complications following cataract

surgery, microbial keratitis, advanced glaucomatous optic atrophy, ocular trauma, macular degeneration, central chorioretinitis, amblyopia and retinal detachment.<sup>(3)</sup>

We sought to analyze the visual outcomes of cataract surgery in 40 consecutive one-eyed patients performed by a single ophthalmologist in a secondary care hospital in the Eastern Uttar Pradesh region of India over duration of 4 years. The visual outcomes measured were post-operative BCVA, endothelial cell count loss, peribulbar IOP changes, pre and post-operative keratometric astigmatism changes.

## METHODOLOGY

Prospective one-eyed patients meeting the inclusion criteria of having significant operable cataracts in the good eye with well controlled systemic comorbidities were taken up for the study. Exclusion criteria were eyes with any amount of zonular dialysis, central endothelial cell counts less than 1500 cells/mm<sup>2</sup>, glaucoma, diabetic retinopathy, vascular occlusions, macular diseases, optic nerve deficit, retino-choroiditis and eyes with NLD block which were referred to a tertiary care centre. Special attention was given to eyes with pseudo-exfoliation. All these cases were followed up for Best Corrected Visual Acuity (BCVA), endothelial cell counts, corneal pachymetry and keratometric changes and IOP changes during peribulbar block. These readings were taken before surgery and on post-op day 1, 7, 28 and 42.

The pre-operative, intra-operative and post-operative protocols followed were as follows.

### 1. Preoperative evaluation of the patient

Patients underwent preoperative systemic examination and investigations which included; complete blood counts, blood urea & creatinine, blood sugar, HIV, HBSAg and ECG.

Patients with systemic illnesses were referred to the physician for optimal control. All cases were subjected to pre-anaesthetic checkup (PAC) and fitness prior to surgery.

#### *Ophthalmic Work up included:*

- a. Anterior segment evaluation by slit lamp

- b. Fundus evaluation by direct ophthalmoscopy and/or indirect ophthalmoscopy
- c. Intra-ocular pressure measurement by Goldman Applanation Tonometry
- d. Tear Break Up Time (TBUT)
- e. IOL power calculation by IOL master using Sanders, Retzlaff, Kraff- T formula (SRK-T)
- f. OCT for central macular thickness
- g. USG-B/A scan if retina not visualized
- h. Naso-lacrimal syringing was done at the first visit of the patient
- i. Endothelial cell density and pachymetry measured using specular microscope, Tomey EM-400 (Tomey corp Japan)
- k. Conjunctival swab 4 days prior to surgery for culture. Any growth, excluded surgery.<sup>(4)</sup>

Patients were manifested for surgery only after thorough counseling and informed consent.

### 2. Preoperative protocol

Topical Moxifloxacin 0.5% tds 3 days prior to the surgery

Topical Flurbiprofen 0.03% tds 1 day prior to surgery

Tab Ciprofloxacin 500 mg twice a day, a day prior to surgery

Tab Alprazolam 0.25 mg, a night prior to surgery

Tab Acetazolamide 250 mg, 1hour prior to surgery

On the day of surgery, the pupil was dilated Phenylephrine 5% and Tropicamide 0.8% instilled every 10 minutes an hour prior to surgery.

Patient's routine medications were continued as per the PAC instructions.

### 3. Surgical Procedure

All patients were IV cannulated with multi-parameter monitoring.

- a. All cases were operated under peribulbar anaesthesia.
- b. Prior to and after the peribulbar block, povidone iodine 5% was instilled in the conjunctival cul de sac with a contact period of at least 5 mins. This was repeated prior to draping of the eye before surgery.
- c. The peribulbar block was administered by the surgeon himself. The anaesthetic mixture consisted of 15 ml of lignocaine 2% with 15 ml of 0.5% bupivacaine. Hyaluronidase 1500 IU was added to this mixture. 7 cc of this mixture was injected with a 22 G one-and-a-half-inch needle as per standard technique. <sup>(5)</sup>
- d. The intraocular pressures were recorded with the rebound tonometer (iCare, Finland Oy) immediately prior to and 5 mins after the peribulbar block. Post measurement, an ocular massage was done to ensure an IOP <20 mm Hg in all patients prior to incision and surgery. In cases with persistent elevated IOP post block and massage, surgery was deferred.

#### A. Operation theatre conduct

- a. One-eyed patients were given priority in every ophthalmic OT list and taken up as the second case of the day.
- b. The patient was advised to bathe and shampoo prior in the morning.
- c. Eyelashes and conjunctival cul de sac were cleaned a day prior to the surgery and prior to draping with Povidone – Iodine 5% solution. <sup>(6)</sup>
- d. The patient was given freshly laundered and ironed OT scrubs on entering the operation theatre.
- e. The ambient temperature of the OT was maintained at 21 or 22 degrees centigrade. <sup>(8)</sup>
- f. Unidirectional laminar flow with a positive pressure differential HEPA filtered OT air with 4-6 fresh air/20 air changes per hour and a Relative Humidity of 50 to 55% was maintained. <sup>(7,8)</sup>

- g. The conduct of the surgery was done with an emphasis on using ETO sterilized disposable instruments and drapes and an exclusive cataract instrument set for each patient. The autoclave records, the physical and chemical indicators of successful autoclaving of the ophthalmic instruments and consumables were checked prior to the start of the operation schedule. <sup>(8)</sup>
- h. The fluid for irrigation for the surgery was commercial company packaged sterilized normal saline 0.9%. No antibiotic was used in the infusion fluid.
- i. The ophthalmic OT was an exclusive one which was dedicated solely for ophthalmic surgeries with the entire conduct of the surgery done by a dedicated eye surgery crew wherein no other “outsiders” were permitted.
- j. Surface disinfection and fumigation of the ophthalmic OT was meticulously done a day prior to every surgery.

#### B. Details of surgery and intraoperative maneuvers

All patients underwent phacoemulsification with PCIOL implantation.

- a. The phacoemulsification surgery was performed with Alcon Infiniti vision system with a conventional longitudinal (non-torsional) phacoemulsification hand piece with a 45-degree beveled tip. The intraoperative parameters used during nucleofractis were 45-degree bevel, bottle height of 92 cm, phacopower of 55% (50-65%), Aspiration Flow Rate AFR OF 30 ml/min (30-35ml/min), vacuum of 330mmhg(330-380mmhg), power modulation 50 pulses per sec (PPS) and duty cycle 50:50 adjusting for the hardness of the cataract. All the phacoemulsification and anterior vitrectomy consumables like phaco tips, phaco and I&A infusion sleeves, vitrectomy cutters, cassettes etc. were exclusively used for the one-eyed

patient's surgery as per the extant protocol.

- b. Only disposable drapes were used.
- c. The capsule was stained for visualization using trypan blue dye
- d. The soft-shell technique using Hydroxyl Propyl Methyl Cellulose (HPMC 2%, Appavisc PFS, Appasamy ocular devices) and Sodium hyaluronate (Cohevisc appasamy ocular devices).<sup>(9)</sup>
- e. The surgeon used the "Stop and chop" technique and the "direct chop method" as required.
- f. Intra-operative mydriasis was ensured with the addition of 0.1 ml of 1:10000-intracameral epinephrine (Epitrate intracameral injection, Sunways India) as and when required.
- g. Small pupils were addressed with stretch pupilloplasty by Kuglen's hooks or sphincterotomy by placing four radial cuts with a micro vitreal scissor.
- h. An intracameral injection of 0.4 ml of 150mcg/0.1 ml preservative free Moxifloxacin 0.5% (Vigamox) was given.
- i. The side ports and the main incision were stromally hydrated with 0.9% normal saline to ensure that the sections were sealed.
- j. The patient's eye received a subconjunctival injection of 0.1ml (0.4mg/0.1ml) of Dexamethasone plus 0.1ml (25mg/0.1ml) of Amikacin in the inferior bulbar conjunctiva.
- k. The patient's eye was bandaged with an eye patch and was escorted and detained for the duration of the peribulbar block. After ascertaining the return of lid mobility once the peribulbar block wore off, post-op topical antibiotic and steroid medication was started within 2 hours.

### 3. Post-operative regimen

The patients were examined on post-op day 1, 7, 28 and 42. All patients were put on a

tapering dose of antibiotic and steroid (Moxifloxacin 0.5% and Prednisolone 1%) eye drop for duration of 6 weeks. Patients were given Paracetamol and Ibuprofen twice daily for 2 days post-surgery. Corneal edema if any was treated with hypertonic saline drops (Hypersol 5%) 5 times a day and ointment hypertonic saline (Hypersol 6%) nightly for 2 weeks. The patient's operated eye was evaluated for UCVA, corneal edema, anterior chamber reaction and IOL centration and the presence of fundal glow and IOP on the first post-op day and on all subsequent visits.

### RESULTS

1. The visual results of all the 40 one-eyed patients in this cohort showed a significant improvement between 6/6 and 6/18 (graded as good: 6/6-6/18; borderline: 6/24-6/60, poor: less than 6/60). The mean pre-op visual LogMAR acuity was 0.8(0.18) and the mean post-op improvement in visual LogMAR acuity was 0.16(0.14).
2. The patients' ages ranged from 57 to 81 years, with 21 males and 19 females. Of the 40 eyes operated 21 were right eyes and 19 left eyes.
3. The causes for blindness in fellow eyes in this study were corneal leucoma opacity 32.5%, complicated cataract surgery 17.5%, pthisis bulbi 15%, corneo-iridic scar 15%, retinal macular scar 12.5%, traumatic optic neuropathy 12.5% and retinal detachment 10%.
4. The ocular surface and tear film values were within normal limits as tested by the TBUT and Schirmer's test.
5. The pre-op conjunctival swabs taken for all patients in this study tested negative.
6. The mean preop endothelial cell count was 1909 cells/mm<sup>2</sup> (87.23). The mean post- op endothelial cell count on day 42 was 1679 cells/mm<sup>2</sup> (88.14). The mean endothelial cell loss was 229.62 cells/mm<sup>2</sup> (12%).
7. The mean preop pachymetry was 559.3 microns (21.12). The mean post-op pachymetry at day 42 was 568.1 microns (22.20). The mean difference in the pre- and post-op pachymetry was 8.8 microns (2.67) at the end of 6 weeks.



8. The mean pre-peribulbar IOP was 17.4 mmHg (1.97); the mean post-peribulbar IOP measured at 5 mins post block was 24.25 mmHg (2.00). The average pressure rise due to the peribulbar block was noted to be 6.78 mm Hg (2.12) in this study.
9. Astigmatism noted preoperatively in this cohort was 23 % With The Rule (WTR), 67% Against The Rule (ATR) and 10% Oblique. Postoperative changes noted were 13% WTR, 57% ATR and 30% Oblique due to surgically induced astigmatism.

## DISCUSSION

The visual acuity outcome in these 40 one-eyed patients was a mean improvement of 0.8 LogMAR to 0.16 LogMAR VA.

The Snellen's acuity was between 6/6 and 6/18 in 100 % of the patients which was in consonance with the WHO successful visual outcomes criteria.<sup>(10)</sup>

In the Indian population, the endothelial cell density has been estimated to be  $2527 \pm 337$  cells/mm<sup>2</sup>.<sup>(11)</sup> The mean preop endothelial cell counts in our patients was 1909 cells/mm<sup>2</sup> (87.23). The mean postop endothelial cell counts were 1679 cells/mm<sup>2</sup> (88.14). The mean endothelial cell loss was 229.62 cells/mm<sup>2</sup> (12%) in this study which can be accounted by the fact that the majority of our patients were older (60 - 80 years). Maggon et al compared postop endothelial cell counts after 4 weeks of phacoemulsification by direct chop technique in 150 eyes of 150 patients in the age group of 50 -70 years. The endothelial cell loss was 160 cells/mm<sup>2</sup> (6.47%) in the group with > 7mm pupil size.<sup>(12)</sup> In the study by Ventura et al where corneal thickness and endothelial density before and after phacoemulsification was evaluated, it was found that despite the significant post-op corneal swelling and endothelial cell losses (346 cells/mm<sup>2</sup> 16%) after surgery, it did not translate into decreased visual acuity.<sup>(13)</sup> This enabled the conclusion that as long as the numerical density of the corneal endothelial cells did not fall below the physiological threshold, a moderate decrease in this parameter, neither compromised the pumping activity of the corneal endothelium nor adversely affected the visual acuity which was our observation too in the present study.

The mean pre-op corneal pachymetry values in our study was 559.3 microns (21.12). The mean post-op pachymetry at 6 weeks was 568.1 microns (22.20). The mean difference in the pre and post-op pachymetry was 8.8 microns (2.67) which amounted to 1.57% increase of corneal thickness at the end of 6 weeks. Maggon et al reported a range of 0.04% to 1.4% percentage increase in corneal thickness depending on the pupillary size at 4 weeks postop.<sup>(12)</sup> In a study by Sachin M Salvi, it was found that corneal pachymetry remained increased by 6.44% on day 1 postoperatively and gradually reduced to pre-op levels after 1 week postoperatively (0.57% difference).<sup>(14)</sup>

The corneal endothelial cell loss is influenced by type of surgery (phacoemulsification or SICS or ECCE), technique of surgery (Stop and chop versus direct chop), use of visco elastics and the type of IOL used.<sup>(15,16,17,18,19,20)</sup>

Percentage changes of WTR, ATR and Oblique astigmatism at 6 weeks postop due to the surgically induced astigmatism in our study showed an increase of 20% in Oblique astigmatism with a decrease of 10% of ATR astigmatism and a 10% decrease in WTR astigmatism. The length and configuration of the corneal incision was the same in all the 40 eyes as it was performed by the same surgeon in this study. WTR astigmatism decreases with advancing age to ATR astigmatism at approximately 60 years. Hayashi et al in their study compared the astigmatic changes over twenty years of two groups of patients those with and without cataract surgery and concluded that corneal astigmatism continued to change towards ATR over 20 years after cataract surgery. This change was similar in eyes that did not have surgery.<sup>(21)</sup>

Jonathan et al described the post-op keratometric changes in 137 patients who underwent ECCE performed by a single surgeon and described an initial WTR astigmatism which over 48 months of follow up shifted to ATR astigmatism with no suture removal.<sup>(22)</sup> Our study found a cumulative shift towards Oblique astigmatism over a 6-week follow up period which was the consequence of a superiorly placed incision at 11<sup>o</sup> clock position in all the cases by the same surgeon.

Intraocular pressures were recorded with a rebound tonometer (iCare, Finland Oy) immediately prior to

the block and 5 mins after the peribulbar block. A 7 ml mixture of Bupivacaine 0.5% and Lignocaine 2% was administered by the same surgeon using the same technique in all the 40 cases. Post peribulbar block, IOP was measured at 5 mins and thereafter, all patients received ocular compression to ensure that the IOP was < 20mmHg prior to incision and entry into the eye. The average IOP increase measured at 5 mins post block without ocular compression was 6.78 mmHg(2.12) in this study. Bowman, Liu and Sarkies using 10 ml of anaesthetic agents reported mean IOP values noted immediately after the block administration as 11.44mmHg (8.97-13.90) in one group with no ocular compression and 9.45mmHg(6.90-12.00) rise in another group subsequently subjected to ocular compression wherein the rate of IOP fall was studied.<sup>(23)</sup>

## CONCLUSION

The safe and successful outcomes of surgery in all 40 patients were evidenced by a Snellen's acuity of 6/6 to 6/18 and a mean LogMAR VA increase of 0.16.

The favorable outcomes were due to robust adherence to stringent patient inclusion criteria, customized ophthalmic sterility protocols for a secondary care setting, mandatory conjunctival swab cultures, phacomachine parameter optimization, stop and chop technique, optimal choice of viscoelastics, peribulbar bloc with fixed anesthetic mixture and volume, and continuous IOP monitoring and control.

## ACKNOWLEDGEMENTS

Dr Kreedha Rudraaksh for making it happen and her brilliant inspiration, Dr Anurakshit Gupta for his acerbic wit, guidance, persistent goading and candor, Dr Shantanu Khanna for his magnanimous contribution and time.

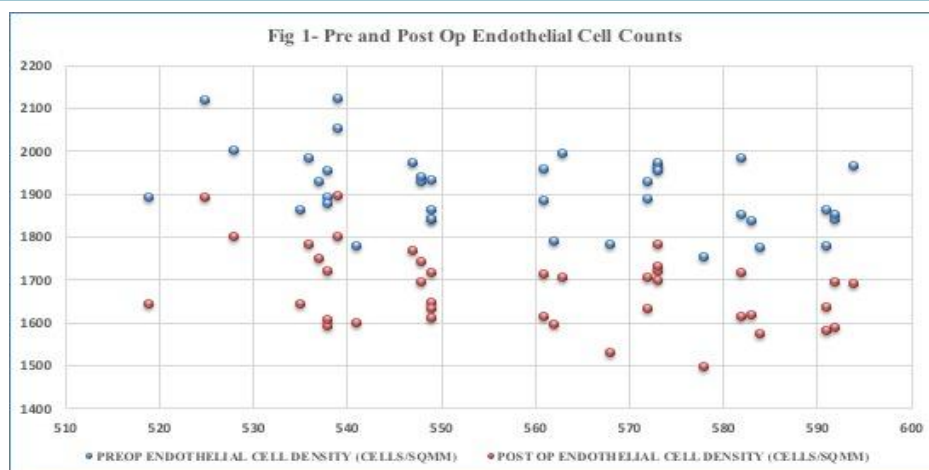
## REFERENCES

1. Kirby, D. B.: Cataract surgery in one-eyed patients. *Tr. Am. Acad. Ophth.*, 54:542-560 (May- June) 1950.
2. Alston Callahan cataract extraction in the one eyed patient: a study of 103 consecutive cases *AJO* vol 35(9)page 1285-1290
3. Definition of blindness under National Programme for Control of Blindness: Do we need to revise it? Praveen Vashist, Suraj Singh Senjam, Vivek Gupta, Noopur Gupta,

Atul Kumar *Indian J Ophthalmol.* 2017 Feb; 65(2): 92–96. doi: 10.4103/ijo.IJO\_869\_16

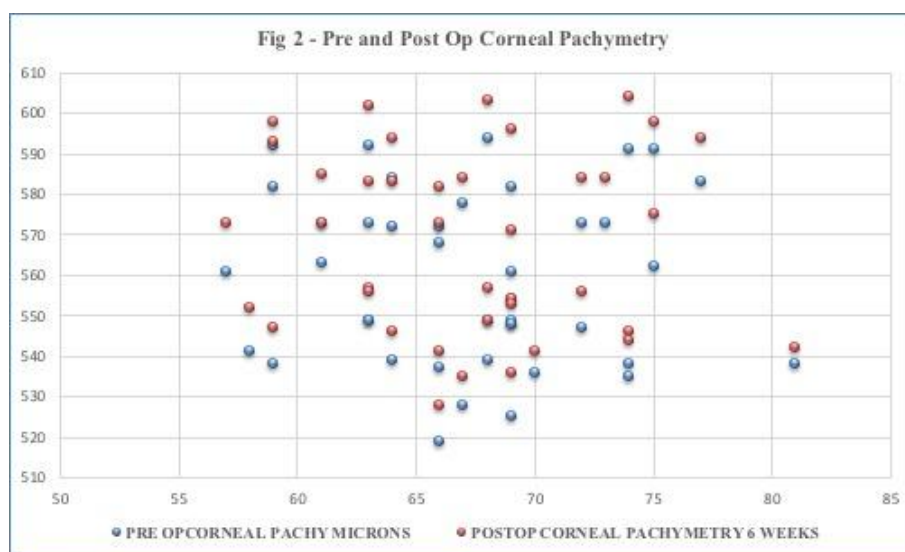
4. Hayashi, Yuko et al. "Bacteriology of the conjunctiva in pre-cataract surgery patients with occluded nasolacrimal ducts and the operation outcomes in Japanese patients." *BMC ophthalmology* vol. 17,1 15. 20 Feb. 2017
5. Davis II DB, Mandel MR. Posterior peribulbar anesthesia : An alternative to retrobulbar anesthesia. *Indian J Ophthalmol* 1989;37:59-61
6. Ferguson AW, Scott JA, McGavigan J, Elton RA, McLean J, Schmidt U, Kelkar R, Dhillon B. Comparison of 5% povidone-iodine solution against 1% povidone-iodine solution in preoperative cataract surgery antisepsis: a prospective randomised double blind study. *Br J Ophthalmol.* 2003 Feb;87(2):163-7.
7. Revised Guidelines for Air Conditioning in Operation Theatres – NABH-Air Conditioning OT (2018)
8. Sharma S, Bansal AK, Gyanchand R. Asepsis in ophthalmic operating room. *Indian J Ophthalmol* [serial online] 1996 [cited 2021 Apr 4];44:173-7. Available from: <https://www.ijo.in/text.asp?1996/44/3/173/24582>
9. Arshinoff SA. Dispersive-cohesive viscoelastic soft shell technique. *J Cataract Refract Surg.* 1999 Feb;25(2):167-73. doi: 10.1016/s0886-3350(99)80121-7. PMID: 9951659].
10. World Health Organization. Informal Consultation on Analysis of Blindness Prevention Outcome. WHO/PBL/98-68. Geneva: World Health Organization; 1998.
11. Rao SK, Ranjan Sen P, Fogla R, Gangadharan S, Padmanabhan P, Badrinath SS, *et al.* Corneal endothelial cell density and morphology in normal Indian eyes. *Cornea* 2000;19:820-3.

12. Maggon R, Bhattacharjee R, Shankar S, Kar RC, Sharma V, Roy S. Comparative analysis of endothelial cell loss following phacoemulsification in pupils of different sizes. *Indian J Ophthalmol* 2017;65:1431-5
13. Ventura AC, Wälti R, Böhnke M. Corneal thickness and endothelial density before and after cataract surgery. *Br J Ophthalmol* 2001;85:18-20.
14. Salvi SM, Soong TK, Kumar BV, Hawksworth NR. Central corneal thickness changes after phacoemulsification cataract surgery. *J Cataract Refract Surg* 2007;33:1426-8.
15. Bourne RR, Minassian DC, Dart JK, Rosen P, Kaushal S, Wingate N. Effect of cataract surgery on the corneal endothelium: modern phacoemulsification compared with extracapsular cataract surgery. *Ophthalmology*. 2004 Apr;111(4):679-85. doi: 10.1016/j.ophtha.2003.07.015. PMID: 15051198.
16. Pirazzoli G, D'Eliseo D, Ziosi M, Acciarri R. Effects of phacoemulsification time on the corneal endothelium using phacofracture and phaco chop techniques. *J Cataract Refract Surg* 1996;22:967-9.
17. Gogate P, Ambardekar P, Kulkarni S, Deshpande R, Joshi S, Deshpande M. Comparison of endothelial cell loss after cataract surgery: phacoemulsification versus manual small-incision cataract surgery: six-week results of a randomized control trial. *J Cataract Refract Surg*. 2010 Feb;36(2):247-53. doi: 10.1016/j.jcrs.2009.09.023. PMID: 20152605.
18. Werblin TP. Long-term endothelial cell loss following phacoemulsification: Model for evaluating endothelial damage after intraocular surgery. *Refract Corneal Surg* 1993;9:29-35.
19. Sugar J, Mitchelson J, Kraff M. Endothelial trauma and cell loss from intraocular lens insertion. *Arch Ophthalmol* 1978;96:449-50.
20. Nayak BK, Jain EK. Comparison of corneal EC loss during PKE using continuous anterior chamber infusion versus those using ophthalmic viscosurgical device: Randomized controlled trial. *Indian J Ophthalmol* 2009;57:99-103.
21. Hayashi, Ken MD\*; Manabe, Shin-ichi MD; Hirata, Akira MD; Yoshimura, Koichi MD Changes in corneal astigmatism during 20 years after cataract surgery, *Journal of Cataract & Refractive Surgery*: May 2017 - Volume 43 - Issue 5 - p 615-621 doi:10.1016/j.jcrs.2017.02.028
22. Jonathan H. Talamo, Walter J. Stark, John D. Gottsch, Daniel F. Goodman, Kimberly Pratzner, Thomas V. Cravy, Cheryl Enger, Natural history of corneal astigmatism after cataract surgery, *Journal of Cataract & Refractive Surgery*, Volume 17, Issue 3, 1991, Pages 313-318,
23. Bowman R, Liu C, Sarkies N. Intraocular pressure changes after peribulbar injections with and without ocular compression. *British Journal of Ophthalmology* 1996;**80**:394-397.



X axis: Corneal thickness in microns

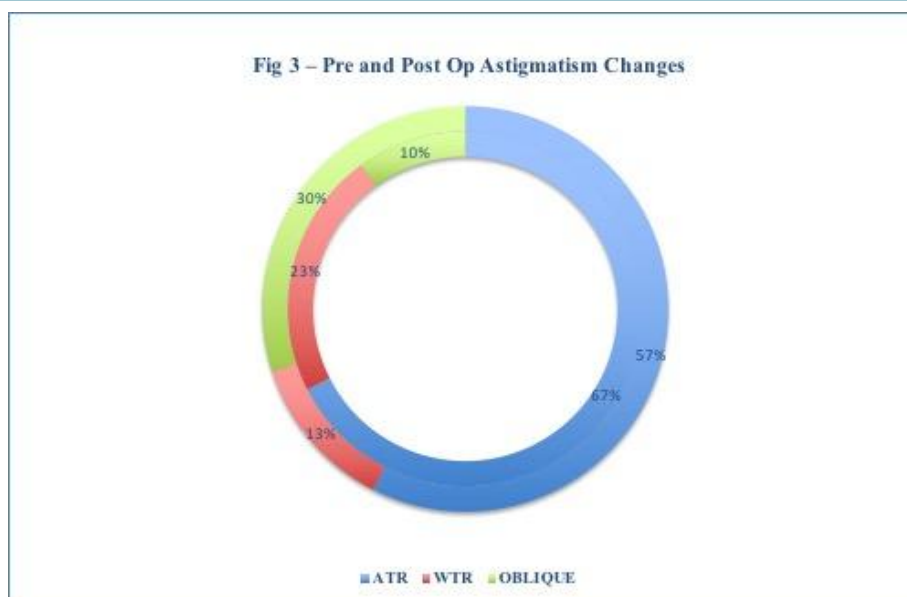
Y axis: Endothelial cell count cells/mm<sup>2</sup>



X axis: Age of patients in years

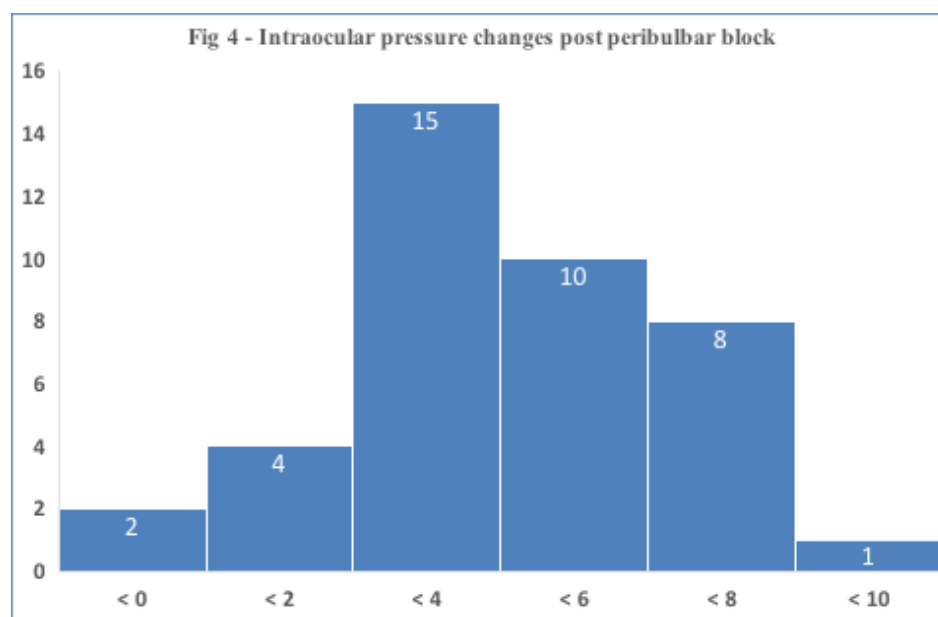
Y axis: Corneal thickness in microns





Inner circle: Preoperative astigmatism type

Outer circle: Postoperative astigmatism type



X axis: IOP in mmHg

Y axis: Number of patients