



CHANGES IN MACULAR THICKNESS FOLLOWING UNEVENTFUL CATARACT SURGERY AT A TERTIARY CARE CENTRE: 3 MONTHS FOLLOW UP STUDY.

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ABSTRACT

Background: Cataract is globally a primary cause of preventable blindness and visual impairment with a prevalence of 47.8%. Small-incision cataract surgery (SICS) and phaco-emulsification are the most commonly performed cataract surgeries. However, they are often associated with postoperative risks like cystoid macular edema. In advent of same the current study aimed to identify the macular thickness following uneventful phacoemulsification & small incision cataract surgery method (SICS) comparison with visual acuity. **Material & Method:** A prospective observational study was undertaken for a period of 1 year from April 2022 to March 2023 on all cataract patients who presented to the OPD at Department of Ophthalmology, IMCHRC, Indore. 100 patients who qualified the inclusion criteria were enrolled with random allocation into 2 surgery group i.e., Group A (N=50); patients who underwent SICS for one eye with bag polymethacrylate IOL implantation and Group B (N=50); patients who underwent phacoemulsification method in one eye with in bag acrylic type of foldable IOL. Postoperative follow up was done on day 7, week 2 and week 4 and upto 3 months. The complete ophthalmological examination and OCT of macula was done at follow-up. Statistical analysis was done with data collected as per the objectives of the study. **Results:** Subclinical macular oedema noted in two cases at 1st, 2nd and 4th week follow-up, but it was reduced at 3rd month. A statistically significant ($P < 0.05$) was observed in macular thickness between the preoperative & post operative 1st week, post-operative 2nd week & post-operative 4th week follow-up in Phacoemulsification group. Patients who underwent SICS procedure also showed statistically significant difference ($P < 0.05$) between the preoperative & postoperative macular thickness on follow-ups without affecting the final visual acuity. **Conclusion:** Phacoemulsification procedure showed increased macular thickness without affecting the final visual outcome postoperatively as compared to SICS. Subclinical macular edema was noted at 1st week which subsequently reduced at 3rd month.

KEYWORDS : Central macular thickness, cataract, SICS, phacoemulsification

INTRODUCTION

Cataract is primary cause of preventable blindness and visual impairment with a global prevalence of 47.8%. Cataract surgery is the commonest ophthalmic surgery performed with Small-incision cataract surgery (SICS) and phacoemulsification being the most common.¹ Every intraocular procedure, including cataract surgery, causes an immune system response, which is the result of a biochemical cascade of events (inflammatory response) or damage to the iris blood vessels and non-pigmented ciliary epithelium.^{2,3} Advanced surgical techniques and pharmacological therapy have significantly decreased this response and, as a result, have reduced postoperative complications after cataract surgery, such as rupture of the posterior lens capsule or vitreous loss and cystoid macular oedema. Uneventful cataract surgery leads to minor retinal changes including subclinical cystoid macular oedema and angiographically detected retinal leakage.^{6,9} The long-term consequences of these findings are however not clearly known.²⁻⁹

SICS with implantation of an intra-ocular lens has been the preferred technique among cataract surgeons, especially beginners. SICS is precise, effective, and less time-consuming without maintenance demand of equipment.¹⁰ Also, it has been proven to be safe and effective in all types and grades of cataract. It has been observed that SICS gives lesser post-operative astigmatism, better post-operative visual outcome, comfort, and faster rehabilitation than the conventional ECCE technique.¹¹ However, some degree of macular damage, clinically demonstrable as macular edema, continues to occur even after uneventful cataract surgery.

Further, Phacoemulsification with foldable posterior chamber intraocular lens (PCIOL) is considered as standard surgery with lesser complications. With modern techniques i.e.,

Phacoemulsification, incidence of macular edema is less than previous techniques.¹²⁻¹⁵

Cystoid macular edema (CME) is one of postoperative manifestation that may lead to vision deterioration after any intra-ocular surgery if precautions are not taken adequately to avoid, diagnose, or treat it.¹ The overall incidence of clinical CME after uneventful cataract surgery was 1.5%. Following SICS, the incidence of clinical CME was 2%, and that after phaco-emulsification was 1%. The incidence of angiographic leakage after uneventful cataract is exists between 9.1% and 20.4%.¹³⁻¹⁵

Macular edema (ME) is defined as an abnormal increase of fluid volume in the macula. The anatomical process involves intra-cytoplasmic swelling of glial cells leading to cell swelling. Gradually, the fluid starts accumulating in inter-cellular spaces, invading retinal layers and leading to the formation of "cysts".¹⁶ CME usually appears within 1-3 months after cataract surgery as either reduced visual acuity or changes on fluorescein angiography or optical coherence tomography (OCT). Most patients recover spontaneously, with full restoration of visual acuity within 6 months; however, it may take up to 1-2 years for complete resolution. However, a clinically significant reduction in visual acuity is observed in about 1% of these eyes. If complications occur during cataract extraction, such as posterior capsule rupture, vitreous loss, severe iris trauma, or vitreous traction at the wound, there is a significant increase in the incidence (up to 20%) of clinically apparent CME.¹⁷

Macular edema can also be found in cases of diabetic retinopathy, age-related macular degeneration, venous occlusion, hypertensive retinopathy, central serous chorio-retinopathy, Irvin-Gass syndrome, pars planitis, uveitis and iridocyclitis, choroiditis, and retinitis pigmentosa.

Macular edema (ME) can be assessed by a number of methods. Traditional methods include contact and non-contact slit lamp biomicroscopy using 60D/78D/90D, indirect ophthalmoscopy, fundus fluorescein angiography, and fundus stereo-photography. OCT has become an important tool in diagnosing and managing retinal disorders such as CME.¹⁷

In advent of same, the present study was aimed to compare macular thickness following uneventful phacoemulsification surgery and SICS procedure and its correlation with visual acuity.

MATERIAL & METHOD

After approval from the institutional ethical committee the present prospective observational study was conducted for a period of 1 year from April 2022 to March 2023 on 100 cataract patients of age ranging from 35-78, who presented to the OPD at Department of Ophthalmology, IMCHRC, Indore and qualified the inclusion criteria. A written informed consent was obtained from all patients. The optical coherence tomography (OCT) was measured to know macular thickness in all patient using spectral domain.

Inclusion Criteria:

Patients who are willing to undergo uneventful cataract surgery; cataract which allows pre-operative OCT.

Exclusion Criteria

Patients who did not consented for the study and Patients having mature, complicated, traumatic cataract, retinal pathology was excluded from the study.

Method

100 patients who qualified the inclusion criteria were enrolled with random allocation into 2 surgery group;

Group A (N=50); Patients who underwent SICS for one eye with bag polymethacrylate IOL implantation and

Group B (N= 50); Patients who underwent phacoemulsification method in one eye with in bag acrylic type of foldable IOL.

Pre-operative examination:

Procedures like Visual acuity check by Snellen chart; Slit lamp biomicroscopy of fundus; OCT fast macular scan, Fundus photography; Retinal thickness analysis, line scans through the fovea and retinal map analysis were carried out. Other examinations like Intraocular pressure (IOP); Patency of the naso-lacrimal duct by syringing; Axial length and General examination were carried out to all patients. Surgical procedure: In phaco-procedure, after superotemporal scleral tunnel incision, a foldable acrylic intraocular lens was inserted in capsular bag. Whereas in manual SICS procedure, the nucleus removed using the sandwich technique and 6.0 mm PMMA single intraocular lens implanted in bag.

Postoperative follow up was done on day 7, week 2 and week 4 and upto 3 months. The complete ophthalmological examination and OCT of macula was done at follow-up.

OCT: All eyes were dilated before OCT examination with 1% tropicamide and 5% phenylephrine hydrochloride. Retinal thickness was measured for each scan. Retinal architecture for retinal edema, cystoid spaces, hard exudates and sub retinal fluid were also examined.

Statistical Analysis

The data was collected on a prestructured proforma and was entered into Microsoft excel 10.0. Statistical analysis was done by SPSS statistical software. Continuous variables, such

as age, were summarized as mean standard deviation [SD]. The mean differences in both groups were analysed through student's 't' test. 95% confidence interval (p value < 0.05) was considered as statistically significant.

RESULT

For Demographic variables, out of the 100 patients, (52 [52%] males and 48 [48%] females admitted with mean age was 60.5 ± 12.5 years (40-75years). The mean age of patients in SICS procedure and phacoemulsification procedure was 60.55 ± 11.45 years and 62.2 ± 10.4 years respectively without significant difference.

In total 100 patients, 80% didn't observed any systemic illness while 20% suffered from hypertension.

For Duration of surgery, Mean phacoemulsification time was 3.16 ± 0.31 minutes and total mean surgical time was 24.8 ± 1.2 minutes in PHACO surgery. In SICS procedure, the mean surgical time observed was 26.2 ± 1.18 minutes, which was more than phaco procedure.

For Visual acuity, a statistically significant difference (p < 0.001) was observed in the mean difference between pre-operative visual acuity in SICS group and in phacoemulsification group. However, it was statistically non-significant postoperatively (p=0.12)

For Macular thickness, Statistical analysis of 5 mean values like pre-operative, postoperative 1st visit; 2nd visit; and 4th week visit and post-operative 3rd month follow-up in SICS procedure was carried out through one-way ANOVA. A statistically significant correlation was observed (p=0.01). Whereas to measure the intergroup differences, Tukey's method post-hoc test performed. There was significant (p<0.01) difference noted between the intergroup macular thickness values.

The sub-clinical macular oedema noted at 1st visit, 2nd visit and 4th week follow-up. But it was reduced at third month follow-up. In phaco group, the differences were statistically insignificant (One-way ANOVA; p=0.09). A statistically significant (Tukey's method post-hoc test; p<0.05) difference was observed between the intergroup macular thickness value. When both procedures SICS and phacoemulsification groups were compared, a subclinical macular oedema was noted up to the 4th week in SICS group.

Table 1: Comparison of visual acuity at different time intervals

	SICS group	Phaco group	P value
Age -years	60.55 ± 11.45	62.2 ± 10.4	Non sig
Duration of surgery	26.2 ± 1.18 min	24.8 ± 1.2 min	Non sig
Visual acuity-Pre op	0.21 + 0.17 (0.14-0.25) decimals (~6/36p)	0.31 + 0.2 (0.26 to 0.37) decimals (~6/18p)	p < 0.001
Visual acuity-post op	0.62 + 0.18 (0.57 to 0.70) decimals (~ 6/9)	0.66 + 0.2 (0.63-0.71) decimals (~ 6/9p).	p < 0.12

Table 2: Mean macular thickness at different time intervals

Macular thickness	Phaco group	SICS group
pre-operative	161.5 + 12.0 (155.5-161.5) u.	166.0 + 15.6 (156.5-170.5) u
1st week	169.75 u + 12.35 (168.5-172.5)	177.1 u + 13.7 (170.5-180.4) u.
2nd week follow-up	170.25u + 11.5 (169.5-174.5) u.	171.5 u + 13.75 (165.55-177.5) u
4th week follow-up	165.5 u + 12.6 (164.5-169.5)	167.75 u + 12.4 (163.5-171.5).

3rd month follow-up	162.6 + 12.8(160.5-165.5) u.	168.5 + 15.5 (160.5-172.5)u.
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DISCUSSION

Following cataract surgery, sub-clinical changes may occur in macular thickness with or without the visual acuity being affected. However, CME is a known complication of cataract surgery, manifesting as effusion of the fluid from the capillaries. Although this phenomenon is most often self-limiting, culminating in spontaneous resolution, it occasionally leads to marked impairment of central vision, which may become chronic or permanent. In recent times although a lot of surgical advances happened in cataract surgery cystoid macular oedema still remains the most common postoperative manifestation.

WHO estimated the present global prevalence of blindness as 0.57% (0.2%–1%), with highest proportion i.e., 82% of all blindness occurring in individuals aged 50 and older. The mean age was 60.5 ± 12.5 years (40-75years) in present study similar to the studies conducted by Vyas VJ et al.¹⁸, Nasreen S et al.¹ and Bhargava S et al.¹⁹ A different age distribution was noted with the study conducted by Salwan A et al.²⁰ A statistically insignificant correlation was observed in age between the two surgical groups i.e., phacoemulsification & SICS which was in concurrence with study done by Ghosh et al.²¹ & Nasreen S et al.¹

As a postoperative complication, Nakayama et al.²² in his study revealed that increase in macular thickness, aqueous flare and cells was identified in diabetic eyes. Progressive increase in macular thickness was identified after 6 months with decrease in visual acuity due to macular oedema.

In the present study the total mean surgical time in PHACO surgery was less as compared SICS procedure with mean surgical time was 24.8 ± 1.2 minutes and 26.2 ± 1.18 minutes respectively. Ramakrishnan et al.²³ studied the correlation between the duration of surgery and the increase in macular thickness and confirmed our observation that the patients who had a longer duration of surgery showed an increased central macular thickness. Jurecka et al.²⁴, in his study observed a positive correlation between phacoemulsification surgical time and increase in macular volume & retinal thickness at 1st week follow-up and in the 1st and 2nd month follow-up. Whereas, our study didn't show positive correlation which was similar to study done by Nasreen S et al.¹ The cause for this rise in thickness may be subclinical breakdown of the blood retinal barrier.

In our study the phacoemulsification time and axial length doesn't correlate with macular thickness changes. This was similar to results obtained by Nasreen S et al.¹ & Jagow et al.²⁵

No change was observed in the visual acuity in all follow-up visits which was similar to findings of study done by Nasreen et al.¹ However, studies done by Gogate et al.²⁶, Ruit et al.²⁷, and Ghosh et al.²¹, demonstrates that visual outcome was identical with 6 months visit which was contrasting to present.

Polito et al.²⁸, Danis et al.²⁹, studies used fast macular thickness map procedure to measure macular thickness. Whereas our study also used the same protocol to measure macular thickness.

Study by Sourdille et al.³⁰, also reported the changes in macular thickness after uneventful cataract surgery and compared with OCT findings with flare and cells. Brio et al.³¹ in their study showed the changes in foveal & perifoveal thickness after phacoemulsification.

Changes of macular thickness were observed at post operative day 1, day 30, and day 60 and in perifoveal 3.0 and

6.0 mm sectors. Present study also observed similar changes in the phacoemulsification. In the phaco group, there was significant subclinical change in the macular thickness at 1st week.

Ghosh et al.²¹, study demonstrated the central subfield mean thickness in SICS procedure as $192.8 \pm 17.9 \mu\text{m}$, which was not significant than phacoemulsification as $192.1 \pm 27.4 \mu\text{m}$ at 1st postoperative day follow-up. Increase in macular thickness did not affect the final visual outcome. Our study results also showed similar Ghosh et al.²¹ When both groups were compared, subclinical macular oedema was observed up to 4th week in SICS group.

Similarly, Menten et al.³², Biro et al.³¹, and Ghosh et al.²¹, didn't show any clinical macular edema in their study.

It was inferred from the present study that that Subclinical edema is longer in eyes of SICS group when compared to phacoemulsification group without any effect on visual acuity

Our study has some limitations, including a relatively small sample; however, we were able to reduce confounding bias in the groups via randomization. Additionally, information on the condition of the neck vasculature and the use of antihypertensive drugs were not included in this study, which has the potential to influence the results of the OCT-A imaging.

CONCLUSION

Uneventful cataract surgery can lead to minor retinal changes including subclinical cystoid macular oedema higher at 1st week visit and can less at 3rd month follow-up. OCT being a non-contact and non-invasive technique, widely used for the diagnosis of retinal thickness changes and is a unique tool for showing macular pathology showed macular edema without altering architecture of the macula. Subclinical edema is longer in eyes of SICS group when compared to phacoemulsification group without any effect on visual acuity & outcome.

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