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Comparison of central macular thickness after SICS and phacoemulsification cataract surgery, using Oct

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Abstract
Introduction: Cataract surgery is one of the most routinely performed surgeries in the field of Ophthalmology. In most cases, the fundus of a postoperative eye does not show any change macroscopically. However, techniques such as Optical Coherence Tomography (OCT) can help to detect any microscopic changes in the fundus.
Aim: To compare the central macular thickness after SICS to that after Phacoemulsification cataract surgery, using HD-OCT.
Materials and Methods: A prospective study to compare the Central Macular Thickness after SICS and Phacoemulsification cataract surgeries using HD-OCT in 20 patients with Nuclear sclerosis grade II-III cataract, and no posterior segment pathology was done.
Results: Average age of the patients was 61.85 in the SICS group and 64.4 in the phacoemulsification group (Table 1). 45% patients in the SICS group and 50% patients in the phacoemulsification group were males. (Table 2, Figure 3) On post-op day 1, foveal thickness was 198.230±1.027 um in the SICS group and 193.745 ±0.566um, in the phacoemulsification group. On post-op day 7, it was 203.880±1.548um and 197.090±0.461 um, while on post-op day 45 it was 212.095±0.694um and 202.095±0.694um in the SICS and phacoemulsification group respectively. (Figure 3)The p value was noted to be <.001 on all three post-operative days when macular thickness was measured, indicating that the difference between the central macular thickness of the SICS and Phacoemulsification groups was statistically significant.
Conclusion: Hence, we conclude that there was presence of subclinical increase in the central macular thickness following cataract surgery. It was more following SICS than phacoemulsification, and maximum at post-op day 45. It was also observed that recovery was faster following phacoemulsification.

Keywords: OCT, macular thickness, cataract Surgry

Introduction

In many countries since last 10 years, in spite of the progress made in surgical techniques, cataract remains the leading cause of visual impairment in all areas of the world, except for developed countries [1]. Thereby, Cataract surgery is one of the most routinely performed surgeries in the field of Ophthalmology. Though cataract surgery has developed over the years, and usually improves visual outcome, it is still an invasive procedure that causes inflammatory insult to the eye [2]. This inflammatory response is usually mediated by prostaglandins [3]. In most cases, the fundus of a postoperative eye does not show any change macroscopically. However, techniques such as Optical Coherence Tomography (OCT) can help to detect any microscopic changes in the fundus.

With increasing awareness, more and more people are willing to get operated at comparatively earlier stages of cataract- Nuclear Sclerosis grades II-III being the most common as noted in our setting, usually in patients between 55 to 70 years of age. The demand for small incision cataract surgery (SICS) and Phacoemulsification cataract surgery is almost equal amongst the patients that present to us.

Diminution of vision after uncomplicated cataract surgery can be seen due to macular edema, out of most common causes. An increased incidence of postoperative macular edema has been associated with diabetes. In diabetic patient undergoing cataract surgery, the incidence of macular edema on optical coherence tomography (OCT) was 22%. It is difficult to differentiate the cause of macular edema after cataract surgery in diabetic patients as it could be caused by the cataract surgery or diabetes itself.

Cataract surgery induced surgical trauma resulting in prostaglandins release and blood retinal barriers disruption is thought to be the cause of macular edema.

In measuring macular thickness in normal individuals and diabetic patients, OCT has been shown to be highly reproducible. As OCT can assess macular thickness quantitatively, it can detect subtle changes of macular thickness and is especially useful in mild cases [4].

Pseudophakic clinically significant CMO is defined when it is associated with a decrease in visual acuity of 20/40 or worse, it is categorized as clinically significant. The incidence after phacoemulsification is reported to be 0.1–2% in healthy populations.

Hence, we made a decision to conduct a study that can compare the increase in the central macular thickness of patients after SICS to that after phacoemulsification using Optical Coherence Tomography (OCT)

Aim

To compare the central macular thickness after SICS to that after Phacoemulsification cataract surgery, using HD-OCT.

Inclusion and exclusion criteria

This study has been Ethically approved. The patients included were those in the age group of 50-75 years, with Nuclear sclerosis grade II-III cataract, and no posterior segment pathology. Consent to participate in the study, was taken, and patients willing to participate and follow up regularly were included. Patients who were diabetic, and those who underwent any intraoperative complications were excluded.

Finally, 20 eyes underwent SICS, and 20 eyes underwent phacoemulsification, were included in the study. (Figure 1)

Materials and Methods

It was a prospective study to compare the Central Macular Thickness after SICS and Phacoemulsification cataract surgeries, which was conducted at a Medical College and Hospital setting in Navi Mumbai. All patients underwent thorough anterior segment examination, including visual acuity with Snellen's chart, Slit lamp examination, and intraocular pressure measurement with Goldman Applanation tonometry. And routine investigations for medical fitness were done. Posterior segment examination was done with Volk 90 D lenses, and Indirect ophthalmoscopy with Volk 20 D lenses. Keratometry was done with the help of a Bausch and Lomb manual Keratometer, and biometry and IOL power calculation was done with a Zeiss IOL Master. A preoperative OCT was done using the Zeiss Cirrus HD-OCT. The patients who fulfilled the inclusion criteria were posted for surgery. Those who opted for polymethyl lmethacrylate (PMMA) lenses underwent SICS. Those who opted for foldable lenses (acrylic hydrophilic) underwent phacoemulsification. All patients were given preoperative NSAIDs, and postoperative Steroids. Pre and post-operative care was standardised in all patients, with preoperative NSAID and antibiotic combination given for one day before the surgery, and a steroid and antibiotic given after the surgery for a period of 6 weeks. Macular thickness was measured post-operatively on days 1, 7 and 45 using Zeiss Cirrus HD-5000 OCT (Figure 2), with the Macular Cube function. From the inner limiting membrane to the outer boundary of the retinal pigment epithelium, retinal thickness was measured.

Result

Average age of the patients was 61.85 in the SICS group and 64.4 in the phacoemulsification group (Table 1). 45% patients in the SICS group and 50% patients in the phacoemulsification group were males. (Table 2, Figure 3) On post-op day 1, foveal thickness was 198.230±1.027 um in the SICS group and 193.745 ±0.566um, in the phacoemulsification group. On post-op day 7, it was 203.880±1.548um and 197.090±0.461um, while on post-op day 45 it was 212.095±0.694um and 202.095±0.694um in the SICS and phacoemulsification group respectively. (Figure 4, Figure 5) The p value was noted to be <.001 on all three post-operative days when macular thickness was measured, indicating that the difference between the central macular thickness of the SICS and Phacoemulsification groups was statistically significant (Table 3).

Table 1: Descriptive Statistics for Age (in Years)

Group	Mean	N	SD
SICS	61.85	20	9.664
PHACO	64.4	20	5.762
Total	63.125	40	7.959

Table 2: Distribution according to Sex

Sex	Group		Total
	SICS	PHACO	
Male	9	10	19
Female	11	10	21
Total	20	20	40

Table 3: Comparison of Macular Thickness (µm)

Group		N	Mean	SD	SEM	t	df	p-value
Pre-op	SICS	20	184.45	1.491	0.333	-1.391	38	0.172
	PHACO	20	184.375	1.387	0.31			
Post-op Day1	SICS	20	198.23	1.027	0.23	17.103	38	<.001**
	PHACO	20	193.745	0.566	0.127			
Post-op Day7	SICS	20	203.88	1.548	0.346	18.8	38	<.001**
	PHACO	20	197.09	0.461	0.103			
Post-op Day45	SICS	20	212.095	0.694	0.155	45.57	38	<.001**
	PHACO	20	202.095	0.694	0.155			

**: Significant difference at 1% level of significance

Discussion

After cataract surgery, posterior diffusion of inflammatory factors, especially prostaglandins, is supposed to lead to instability of the blood-retina barrier (BRB). The BRB is responsible for restricting movement of plasma constituents into the retina and in maintaining retinal homeostasis [5]. A BRB breakdown leads to increased capillary permeability of the peri-foveal network, and results in intraretinal fluid accumulation both intra and extracellularly. SICS has a larger incision, greater chances of insult to the iris, and thereby, higher inflammation. Phacoemulsification, being a closed chamber surgery, causes lesser inflammation when done well. The postoperative care and regular instillation of drops has a significant effect on the outcome of macular thickness. Poor compliance for medication was seen in patients with poorer educational and/or financial background.

In most cases, uncomplicated cataract does not change the macroscopic fundoscopic appearance of the retina. However, novel non-invasive imaging techniques such as cross-sectional imaging of the retina with the macular cube as seen on HD-OCT have shown that macular thickness may increase after surgery. In many cases of uneventful surgery, this subclinical thickening can be detected with a peak occurring 4–6 weeks after surgery.

M Gharbiya *et al.* demonstrated in study, a decrease in retinal thickness in all macular subfields on the first day after uncomplicated cataract surgery. From the first week onwards, a progressive increase in retinal thickness was recorded with different trends over time of the central fovea (CPT and CSF) with respect to the outer macular area (3 mm and 6 mm). From the first week after surgery, there was a significant increase in retinal thickness of the outer macular area with a peak at 1 month, while retinal thickness of the central fovea began to increase from the first month, with a peak at 2 months. At 6 months after

surgery, retinal thickness tended to normalize in the central fovea, whereas it remained increased in the outer macular area.

It concluded that, Retinal macular thickness can be reliably assess postoperatively by Spectralis OCT which provides objective and highly repeatable measurements of macular thickness. This demonstrated a significant increase in macular thickness with a peculiar regional pattern of distribution over time, where the most significant changes were in the parafoveal area [6].

Giansanti et-al evaluated central macular thickness after cataract surgery in four groups with epiretinal membrane, high myopia, diabetics without retinopathy and healthy subjects. They found a statistically significant increase in CMT was observed from day 30 in patients with epiretinal membrane and diabetic patients, reaching its maximum thickness at day 60, while it was observed only on day 360 in healthy subjects and those with high myopia. Only diabetic group showed statistically significant correlation between CMT and visual acuity [7].

Jae Ho Yoo et-al studied the changes in central subfield macular thickness (CSMT) using optical coherence tomography (OCT) after cataract surgery and evaluated the risk factors of macular oedema. They concluded at 1 month CSMT significantly increased by 22.2 ± 47.10 μm after cataract surgery in the operated eye compared with the fellow eye (p = 0.01). The diabetic retinopathy group and hypertensive group showed more significant increases than the non-diabetic and non-hypertensive group. Macular oedema developed in seven of 55 eyes (12.7%), and they consisted of five moderate or more severe diabetic retinopathies and two epiretinal membrane. Four weeks after surgery, the macular oedema group showed more decrease in visual acuity; however, the CSMT was not correlated with the duration of diabetes mellitus, types of surgical incision, HbA1c or other factors [8].

Von Jagow B et-al studied macular thickness after uneventful cataract surgery determined by optical coherence tomography. Results showed that the mean minimal foveal thickness (MMFT) of the operated eyes and the intraindividual difference of MMFT increased significantly at one day and 6 weeks. MFT in the operated eyes and intraindividual difference of mean foveal thickness (MFT) rose significantly at 1 day, 1 week and 6 weeks (1 day: +10.66 +/- 20.8 micrometre, P = 0,026; 1 week: +15.23 +/- 19.7 micrometre; 6 weeks: +17.33 +/- 14.81 micrometre, P < 0.001). Repeatability was better for MFT in controls (ICR = 0.92) than for MMFT in controls (ICR= 0.77). No clinical cystoid macular oedema was diagnosed in this study. Correlation between macular thickening and visual acuity and selected surgical and biometrical parameters could not be found [9].

N.A. Kazim and B.A. Huges studied changes in macular thickness using optical coherence tomography (OCT) following uncomplicated phacoemulsification cataract surgery in patients with and without diabetes. Results showed the mean foveal thickness in all 24 eyes was 180.5 μm ± 26.3 μm prior to cataract surgery and 196.7 μm ± 30.9 μm following cataract surgery (P < 0.0001). The mean macular thickness was 222.1 μm ± 22.8 μm preoperatively versus 234.6 μm ± 25.2 μm postoperatively (P = 0.0003). In patients with diabetes, mean foveal thickness preoperatively was 194.9 μm ± 18.8 μm and postoperatively 212.8 μm ± 24.0 μm (P = 0.0006). In addition the mean macular thickness in diabetics increased from 230.8 μm ± 8.5 μm preoperatively to 244.6 μm ± 18.8 μm postoperatively (P = 0.0119). Visual acuity showed a mean improvement of 2.5 lines in the entire group and 2.2 lines in diabetics [10].

M. Eleftheridou et-al studied macular thickness alterations with OCT after phacoemulsification and posterior chamber intraocular lens implantation. They divided patients into four groups according preoperative examination: Group 1 (control group-127 eyes): patients without any predisposing factors for CME, Group 2 (37 eyes): patients with diabetes, Group 3 (38 eyes): patients with epiretinal membrane, and Group 4 (25 eyes): patients with glaucoma.

Results showed the mean foveal thickness (MFT) in group 1 was 202±25 μm and after 1 month increased to 212±41 μm. No significant changes were found at 3 and 6 months compared to the preoperative values. In group 2 the initially MFT was 217±38μm and increased significantly to255±81 μm, 243±70μm 234±44μm at 1, 3 and 6 months respectively. Compared to the control group the MFT in group 2 was significantly increased throughout the follow up period. In group 3 the MFT was found to be increased from 220±40μm preoperatively, to 242±58μm the 1st month after the surgery, to 230±35μm and 226±39μm at 3 and 6 months after the surgery and significantly increased (p= 0,026) compared to the control group at all times of evaluation. In group 4 the preoperative MTF was 212±49μm and at 1, 3 and 6 months was 244±83μm, 231±60μm and 222±53μm respectively. The differences detected between the groups 1 and 4 were significant throughout the six month follow up period [11].

It is known that the time taken for phacoemulsification surgery and the phacoemulsification time as well as the phacoemulsification energy may influence the outcome. However, these parameters were not evaluated in our study, as the same set of surgeons performed all surgeries, and nearly the same settings were used for all. The postoperative increase in macular thickness in our study was noted to be slightly more than that in similar other studies. It was noted to be more particularly in those SICS cases which were operated by Resident surgeons. As only uncomplicated cases were considered, it was concluded that this increase can be attributed to the greater amount of time taken by a resident as compared to a seasoned surgeon. Thus surgical time is also a factor determining post-operative macular thickness. It was seen that patients with poorer educational and/or financial background showed poor compliance for medication, and thereby showed higher thickness. Although the increase in central macular thickness is subclinical, and seems to have no effect on the visual acuity (as measured by Snellen's chart), it has been noticed that the contrast sensitivity is affected by the macular thickness. However, these parameters were not included in the study.

Conclusion

Hence, we conclude that there was presence of subclinical increase in the central macular thickness following cataract surgery. It was more following SICS than phacoemulsification, and maximum at post-op day 45. It was also observed that recovery was faster following phacoemulsification.

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