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KEY WORDS: Manual small incision cataract surgery, subfoveal macular thickness, parafoveal macular thickness, perifoveal macular thickness.

PROSPECTIVE OBSERVATIONAL STUDY TO EVALUATE EFFECT OF UNCOMPLICATED CATARACT SURGERY ON CENTRAL MACULAR THICKNESS ASSESSED WITH OPTICAL COHERENCE TOMOGRAPHY.

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ABSTRACT

PURPOSE: To assess the effect of uncomplicated cataract surgery on central macular thickness assessed with Optical coherence tomography.

METHOD: Our study was a Prospective non interventional observational study. In this study 100 eyes of 100 patients were assessed by optical coherence tomography preoperatively and postoperatively at day 1day, 14 day, 28 day after uncomplicated cataract surgery with Posterior Chamber Intraocular Lens (PCIOL) implantation under peribulbar anesthesia. The study included 50 eyes of 50 patients undergoing uncomplicated manual small incision cataract surgery (Group1) and 50 eyes of 50 patients undergoing uncomplicated phacoemulsification cataract surgery (Group 2). Among each group 30 eyes of 30 patients were started postoperatively on topical NSAIDs. Eyes with diseases predisposing them for postoperative macular edema, eyes with preexisting macular edema were excluded. The preoperative and post operative day1, day14, day28 changes in subfoveal, parafoveal and perifoveal thickness of macula on OCT of each group were noted .

RESULTS: The pre operative mean subfoveal thickness, mean parafoveal thickness, mean perifoveal thickness in patients undergoing MSICS with PCIOL(Group 1) and PHACO with PCIOL (Group 2) were 242.08± 11.68 µm, 309.66± 17.88 µm, 269.84± 14.57 µm and 241.88± 14.35 µm, 317.30± 26.16 µm, 267.98± 17.25 µm respectively.

At day 14, postoperative mean subfoveal thickness, mean parafoveal thickness, mean perifoveal thickness in patients undergoing MSICS with PCIOL with and without postoperative NSAIDS were 260.16± 14.76 µm, 328.03± 17.14 µm, 284.13± 20.71 µm and 275.15± 13.43 µm, 335.55± 20.19 µm, 311.25± 69.09 µm respectively.

At day 28, postoperative mean subfoveal thickness,mean parafoveal thickness, mean perifoveal thickness in patients undergoing MSICS with PCIOL with and without postoperative NSAIDS were 245.16± 13.60 µm, 308.20± 16.05 µm, 269.73± 20.76 µm and 252.85± 12.07 µm, 319.50± 21.19 µm, 285.80± 50.53 µm respectively.

At day 14, postoperative mean subfoveal thickness,mean parafoveal thickness, mean perifoveal thickness in patients undergoing PHACO with PCIOL with and without postoperative NSAIDS were 247.36± 13.63 µm, 310.13± 25.71 µm, 262.26± 18.14 µm and 248.75± 15.33 µm, 332.25± 25.90 µm, 290.60± 78.37 µm respectively.

At day 28, postoperative mean subfoveal thickness, mean parafoveal thickness, mean perifoveal thickness in patients undergoing PHACO with PCIOL with postoperative NSAIDS were 238.76± 14.16 µm, 300.06± 27.58 µm, 252.30± 16.79 µm and 242.45± 16.76 µm, 325.70± 25.54 µm, 283.05± 70.33 µm respectively.

Also Phaco energy linearly co relates with postoperative macular thickness, mean subfoveal macular thickness, parafoveal macular thickness, perifoveal macular thickness on postoperative day 14, post operative day 28 is satistically significant high in those patients in whom more phaco energy is used.

INTRODUCTION

Cataract extraction is one of the most commonly performed surgery. Over recent years, the outcome of cataract surgery has improved due consistent innovations in instrumentation, lens design, and surgical technique. Phacoemulsification using small incisions and implantation of a foldable intraocular lens (IOL) is currently the preferred technique. The procedure is efficient, and uneventful surgery is generally associated with good visual results. Nevertheless, cystoid macular edema (CME) may develop, and this can result in suboptimal postoperative vision. It can occur after uncomplicated surgery in patients with otherwise healthy eyes, after complicated surgery, or after surgery in patients with ocular diseases such uveitis or diabetes.

Cystoid macular edema following cataract surgery was initially reported by Irvine in 1953 and demonstrated angiographically by Gass and Norton in 1966, so it is known as the Irvine-Gass syndrome.[1]

The incidence of pseudophakic Cystoid macular edema depends on the Methodology used in its detection. The prophylactic use of non-steroidal anti-inflammatory drugs preoperatively, and the combination of steroids and non-steroidal anti-inflammatory drugs in the postoperative period, is recommended to reduce the incidence of pseudophakic Cystoid macular edema.[2]

Uneventful cataract surgery can, however, lead to minor retinal changes including subclinical cystoid macular oedema and angiographically detected retinal leakage.The use of optical coherence tomography(OCT) in the postoperative period enables the detection of subclinical changes in macular thickness. OCT, being a non-contact and non-invasive technique, is widely used for the diagnosis of macular thickness changes and is a unique tool for showing macular pathology

Macular edema has been studied for long with fluorescein angiography. It is known that in majority of cases following uncomplicated cataract surgery, CME would occur by the 4-6th week and resolve on its own. Fundus fluorescein angiography has been the 'gold standard' for diagnosing subclinical cystoid macular edema; however, non-invasive cross-sectional imaging of the retina with optical coherence tomography (OCT) is equally effective at detecting the condition and offers the ability to quantify and repeat results over time [3] .With the introduction of OCT, CME has been extensively studied. OCT is useful in determining subclinical cystoid macular oedema in uncomplicated cataract surgery patients and detects the presence of retinal thickening and intra-retinal cysts very soon after surgery, thereby facilitating earlier diagnosis and treatment of postoperative CME.

OCT done at various time intervals following cataract surgery indicate that after an uncomplicated cataract surgery, the increase in retinal thickness and macular volume reached the maximum in months 1 and 2 and was likely to decrease after month 3 on. The incidence of CME was 3 %, but clinically significant CME was detected in 1 % of the cases only.[4]

MATERIALS AND METHODS:

The present study "Prospective observational study to evaluate effect of uncomplicated cataract surgery on central macular thickness assessed with Optical coherence tomography." was an observational type of case series study conducted in department of ophthalmology CRGH Hospital. R D Gardi medical college, Ujjain. A total number of 100 cases were enrolled.

METHODOLOGY:

Written informed consent was taken and detailed history of patient was taken noting the ocular complaints, their duration, associated systemic illnesses including diabetes, hypertension etc, and family history for any hereditary diseases, past history of any ocular disease or any medications or intraocular surgeries. General examination included pulse and blood pressure measurement.

The following were the inclusion and exclusion criteria of study:

INCLUSION CRITERIA:

- Patients undergoing uncomplicated phacoe mulsification or manual small incision cataract surgery.
- Patients having normal pre operative central macular thickness.
- Patients willing to take part in the study.

EXCLUSION CRITERIA:

- Patients undergoing complicated cataract surgery.
- Pathologic conditions of the anterior segment e.g. Severe dry eyes, keratopathy, central corneal scarring.
- White mature cataract, dense posterior sub capsular cataract
- Patients with ocular diseases that might influence central macular thickness such as glaucoma, uveitis, diabetes, age related macular degeneration, etc.
- Patients with history of previous intraocular surgeries.
- Inferior quality measurement of Optical coherence tomography due to media opacities, signal strength less than 5, poor fixation.

The patients were divided into two groups as follows

1) Group 1

50eyes of patients undergoing uncomplicated manual small incision cataract surgery.

2) Group 2

50 eyes of patients undergoing uncomplicated phacoemulsification cataract surgery.

Among all patients undergoing uncomplicated cataract surgery the changes on central macular thickness with and without use of topical non steroidal drugs are studied. Among patients undergoing phacoemulsification the effect of phaco energy (in metrics) on central macular thickness is studied.

Optical Coherence Tomography:

Optical coherence tomography was done using the Zeiss Cirrus HD OCT scanners after dilating pupils fully with tropicamide (0.08%) and phenylephrine (5%) eyedrops in every patient using macular cube 512 × 128 and macular thickness was noted. The subfoveal macular thickness was defined as the distance between the innermost foveolar surface and the outermost foveolar surface and was measured using the manually assisted technique of the program with the OCT system software, with the fixation point regarded as the foveal centre.

In this protocol the macula is divided into 9 areas:
Sub foveal thickness (SFT = F1) from a central macular area of one millimeter in diameter, the parafoveal thickness (F2-F5) and the perifoveal thickness (F6-F9), each divided into four quadrants.

The parafoveal and perifoveal diameters measured 2.22 and 3.45 millimeters respectively. Regional variables parafoveal thickness = (F2+ F3 + F4 + F5)/4 and perifoveal thickness = (F6 + F7 + F8 + F9)/4.

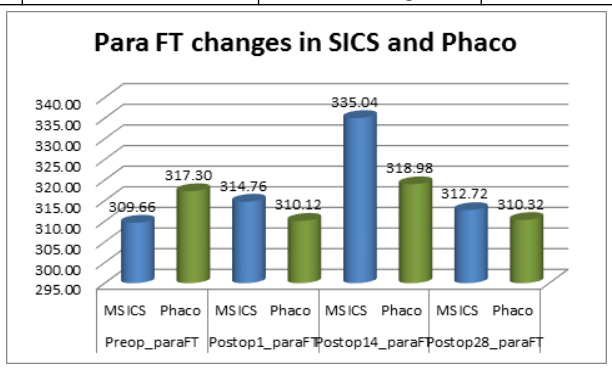
OCT was done pre operative and post operative day 1, day 14 and day 28 following cataract surgery.

RESULT:

In our study among 100 patients 60 were males (60%) and 40 were (40%) females. In our study among the 100 patients 91 patients were in the age group of 50-79 yrs.

Table 1 - Comparisons of OCT mean sub foveal thickness (SFT) in the study groups.

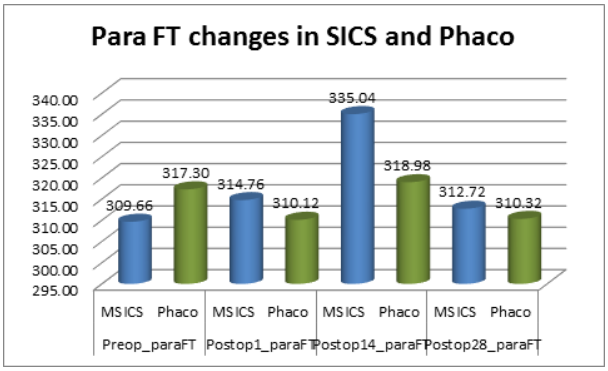
Groups		Preoperative SFT	Postoperative Day 1 SFT	Postoperative Day 14 SFT	Postoperative Day 28 SFT
Group 1	Mean ± SD	242.08 ± 11.68	251.42 ± 11.89	266.16 ± 15.94	248.24 ± 13.44
Group 2	Mean ± SD	241.88 ± 14.35	243.04 ± 14.51	251.92 ± 15.26	242.24 ± 15.69
P value		0.939,NS	0.002, Sig	0.00,Sig	0.043,Sig



The difference of mean sub foveal thickness between before and after surgery in group1 and group 2 on day 14 were statistically significant. P< 0.05 is statistically significant.

Table 2 - Comparisons of OCT mean parafoveal thickness (ParaFT) in the study groups

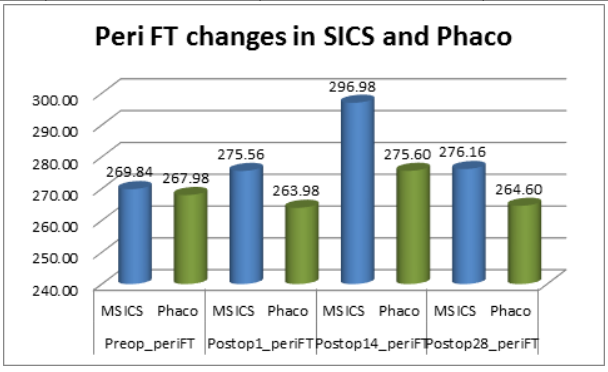
Groups		Preoperative ParaFT	Postoperative Day 1 ParaFT	Postoperative Day 14 ParaaFT	Postoperative Day 28 ParaFT
Group 1	Mean ± SD	309.66 ± 17.88	314.76 ± 18.07	335.04 ± 20.18	314.76 ± 18.07
Group 2	Mean ± SD	317.30 ± 26.16	310.12 ± 27.35	318.98 ± 27.78	310.12 ± 27.35
P value		0.091,NS	0.319, NS	0.001,Sig	0.628,NS



The difference of mean parafoveal thickness between before and after surgery in group1 and group 2 on day 14 were statistically significant. P< 0.05 is statistically significant.

Table 3 - Comparisons of OCT mean perifoveal thickness (PeriFT) in the study groups

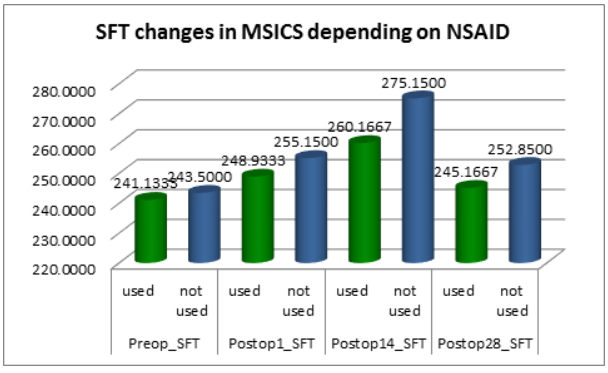
Groups		Preoperative PeriFT	Postoperative Day 1 PeriFT	Postoperative Day 14 PeriFT	Postoperative Day 28 PeriFT
Group 1	Mean ± SD	269.84 ± 14.57	275.56 ± 17.69	296.98 ± 48.56	276.16± 36.18
Group 2	Mean ± SD	267.98 ± 17.25	263.98 ± 15.69	275.60 ± 53.37	264.60 ± 48.13
P value		0.091,NS	0.319, NS	0.001,Sig	0.628,NS



The difference of mean perifoveal thickness between before and after surgery in group1 and group 2 on day 14 were statistically significant. P< 0.05 is statistically significant.

Table 4 - Comparisons of OCT mean subfoveal thickness (SFT) in the MSICS group among those using postoperative NSAIDs and those not using NSAIDs

MSICS Groups		Preoperative SFT	Postoperative Day 1 SFT	Postoperative Day 14 SFT	Postoperative Day 28 SFT
NSAIDs Used	Mean ± SD	241.13 ± 13.62	248.93 ± 12.40	260.16 ± 14.76	245.16 ± 13.60
NSAIDs Not used	Mean ± SD	243.50 ± 8.05	255.15 ± 10.24	275.15 ± 13.43	252.85 ± 12.07
P value		0.48,NS	0.07, NS	0.001,Sig	0.04,Sig

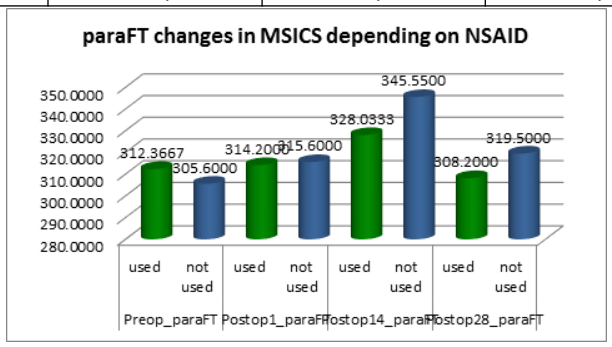


The difference of mean subfoveal thickness between before and after surgery in MSICS groups using postoperative topical NSAIDs and not using NSAIDs on day 14 and day 28 were statistically significant.

Table 5 - Comparisons of OCT mean parafoveal thickness (ParaFT) in the MSICS group among those using postoperative NSAIDs and those not using NSAIDs

MSICS Groups		Preoperative ParaFT	Postoperative Day 1 ParaFT	Postoperative Day 14 ParaFT	Postoperative Day 28 ParaFT
NSAIDs Used	Mean ± SD	312.36 ± 16.93	314.20 ± 18.40	328.03 ± 17.14	308.20 ± 16.05

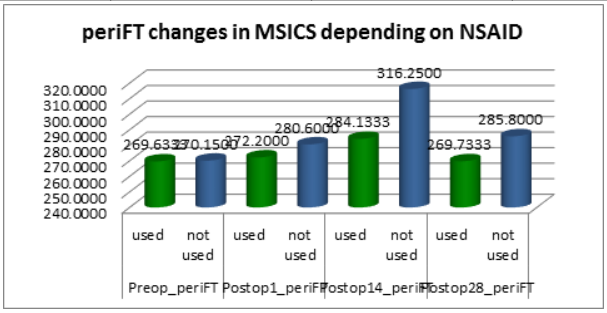
NSAIDs Not used	Mean ± SD	305.60 ± 18.91	315.60 ± 17.98	345.55 ± 20.19	319.50 ± 21.19
P value		0.193,NS	0.79, NS	0.002,Sig	0.037,Sig



The difference of mean parafoveal thickness between before and after surgery in MSICS groups using postoperative topical NSAIDs and not using NSAIDs on day 14 and day 28 were statistically significant.

Table 6 - Comparisons of OCT mean perifoveal thickness (PeriFT) in the MSICS group among those using postoperative NSAIDs and those not using NSAIDs

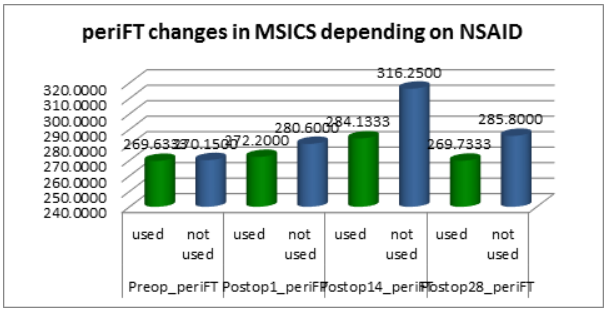
MSICS Groups		Preoperative PeriFT	Postoperative Day 1 PeriFT	Postoperative Day 14 PeriFT	Postoperative Day 28 PeriFT
NSAIDs Used	Mean ± SD	269.63 ± 14.85	272.20 ± 18.28	284.13 ± 20.71	269.73 ± 20.76
NSAIDs Not used	Mean ± SD	270.15 ± 14.50	280.60 ± 15.87	316.25 ± 69.09	285.80 ± 50.53
P value		0.9,NS	0.1, NS	0.02,Sig	0.125,NS



The difference of mean perifoveal thickness between before and after surgery in MSICS groups using postoperative topical NSAIDs and not using NSAIDs on day 14 were statistically significant.

Table 7 - Comparisons of OCT mean subfoveal thickness (SFT) in the Phaco group among those using postoperative NSAIDs and those not using NSAIDs

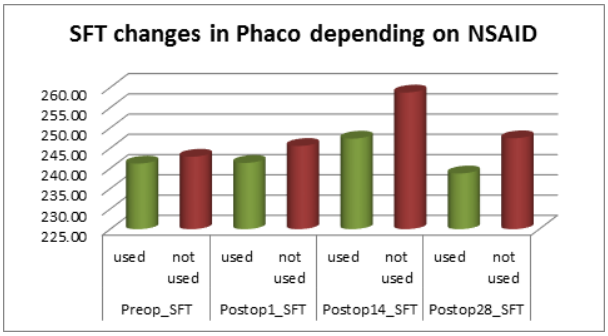
Phaco Groups		Preoperative SFT	Postoperative Day 1 SFT	Postoperative Day 14 SFT	Postoperative Day 28 SFT
NSAIDs Used	Mean ± SD	241.20 ± 13.90	241.37 ± 13.80	247.37 ± 13.63	238.77 ± 14.17
NSAIDs Not used	Mean ± SD	242.90 ± 15.31	245.55 ± 15.52	258.75 ± 15.33	247.45 ± 16.76
P value		0.68,NS	0.323, NS	0.008,Sig	0.054,NS



The difference of mean perifoveal thickness between before and after surgery in MSICS groups using postoperative topical NSAIDs and not using NSAIDs on day 14 were statistically significant.

Table 7 - Comparisons of OCT mean subfoveal thickness (SFT) in the Phaco group among those using postoperative NSAIDs and those not using NSAIDs

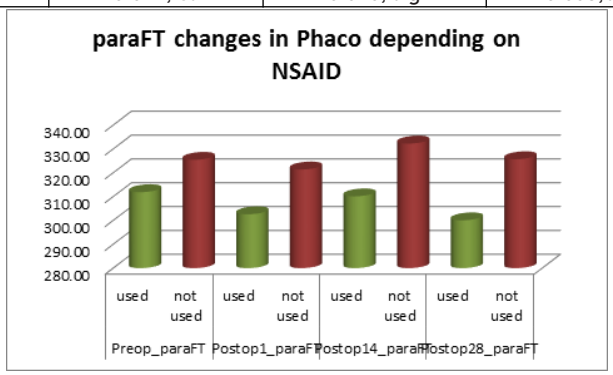
Phaco Groups		Preoperative SFT	Postoperative Day 1 SFT	Postoperative Day 14 SFT	Postoperative Day 28 SFT
NSAIDs Used	Mean ± SD	241.20 ± 13.90	241.37 ± 13.80	247.37 ± 13.63	238.77 ± 14.17
NSAIDs Not used	Mean ± SD	242.90 ± 15.31	245.55 ± 15.52	258.75 ± 15.33	247.45 ± 16.76
P value		0.68,NS	0.323, NS	0.008,Sig	0.054,NS



The difference of mean subfoveal thickness between before and after surgery in Phaco groups using postoperative topical NSAIDs and not using NSAIDs on day 14 were statistically significant.

Table 8 - Comparisons of OCT mean parafoveal thickness (ParaFT) in the Phaco group among those using postoperative NSAIDs and those not using NSAIDs

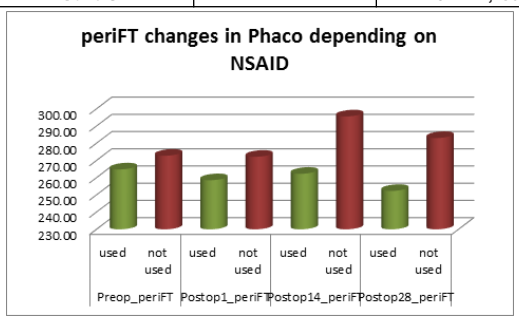
Phaco Groups		Preoperative ParaFT	Postoperative Day 1 ParaFT	Postoperative Day 14 ParaFT	Postoperative Day 28 ParaFT
NSAIDs Used	Mean ± SD	311.87 ± 26.35	302.60 ± 26.14	310.13 ± 25.72	300.07 ± 27.59
NSAIDs Not used	Mean ± SD	325.45 ± 24.26	321.40 ± 25.75	332.25 ± 25.72	325.70 ± 25.55
P value		0.072,NS	0.016, Sig	0.005,Sig	0.002,Sig



The difference of mean parafoveal thickness between before and after surgery in Phaco groups using postoperative topical NSAIDs and not using NSAIDs on day 14 and day 28 were statistically significant.

Table 9 - Comparisons of OCT mean perifoveal thickness (PeriFT) in the Phaco group among those using postoperative NSAIDs and those not using NSAIDs

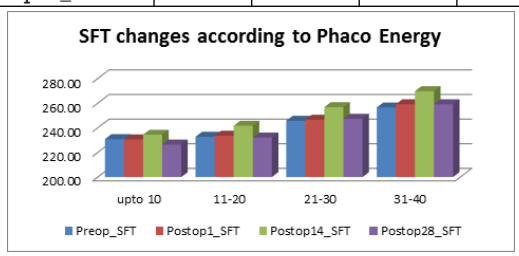
Phaco Groups		Preoperative PeriFT	Postoperative Day 1 PeriFT	Postoperative Day 14 PeriFT	Postoperative Day 28 PeriFT
NSAIDs Used	Mean ± SD	264.80 ± 18.51	258.53 ± 15.17	262.27 ± 18.41	252.30 ± 16.81
NSAIDs Not used	Mean ± SD	272.75 ± 14.30	272.15 ± 11.89	295.60 ± 78.37	283.05 ± 70.33
P value		0.111,NS	0.002, Sig	0.029,Sig	0.025,Sig



The difference of mean perifoveal thickness between before and after surgery in Phaco groups using postoperative topical NSAIDs and not using NSAIDs on day 14 and day 28 were statistically significant.

Table 10 - Comparisons of OCT mean subfoveal thickness (SFT) in the Phaco group according to phaco energy(in metrics).

	Energygr			
	upto 10	11-20	21-30	31-40
Preop_SFT	230.80	232.74	245.71	256.50
Postop1_SFT	230.60	233.58	246.57	259.08
Postop14_SFT	234.40	241.68	256.79	269.75
Postop28_SFT	226.40	232.05	247.29	259.08

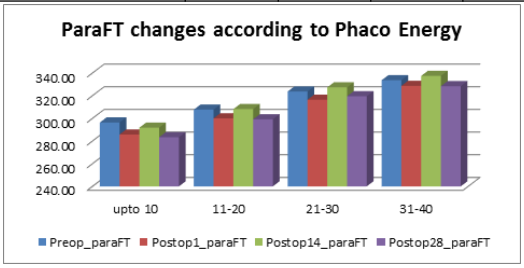


The subfoveal macular thickness was significantly more in the patients in whom more phaco energy (in metrics) was used intraoperatively.

Table 11 - Comparisons of OCT mean parafoveal thickness (paraFT) in the Phaco group according to phaco energy(in metrics).

	upto 10	11-20	21-30	31-40
Preop_paraFT	296.40	307.74	323.71	333.67
Postop1_paraFT	285.80	300.05	316.50	328.75

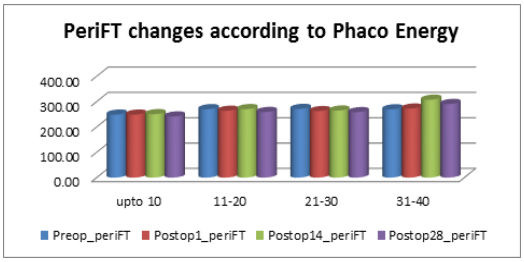
Postop14_paraFT	291.80	308.21	327.43	337.50
Postop28_paraFT	283.40	299.16	319.57	328.42



The parafoveal macular thickness was significantly more in the patients in whom more phaco energy (in metrics) was used intraoperatively.

Table 12 - Comparisons of OCT mean perifoveal thickness (periFT) in the Phaco group according to phaco energy(in metrics).

	upto 10	11-20	21-30	31-40
Preop_periFT	248.60	269.95	271.07	269.33
Postop1_periFT	248.60	263.79	262.50	272.42
Postop14_periFT	250.40	270.32	264.64	307.25
Postop28_periFT	241.20	258.95	258.36	290.58



The perifoveal macular thickness was significantly more in the patients in whom more phaco energy (in metrics) was used intraoperatively.

DISCUSSION:

This Prospective observational non interventional study was undertaken to assess changes in central macular thickness before and after uncomplicated cataract surgery.This change in macular thickness was assessed in subfoveal , parafoveal and perifoveal areas with Optical coherence tomography pre operatively , post operatively on day 1, day 14, day28.

In our study among 100 patients 60 were males (60%) and 40 were (40%)females. In our study among the 100 patients 91 patients were in the age group of 50-79 yrs.

The average age group in our study matched with the age group of a study done by Muhammed ahin et al on Evaluation of Cystoid Macular Edema Using Optical Coherence Tomography and Fundus Autofluorescence after Uncomplicated Phacoemulsification Surgery. Forty eyes of 29 patients were included . Eleven of the 29 patients were male (37.9%), and 18 were female (62.1%). The mean age of the patients was 61.03+/- 16.72years.[5]

Our study assessed effect of MSICS on central macular thickness postoperatively. Most of the studies have been conducted on effect of Phacoemulsification surgery on central macular thickness postoperatively. In a study by Gerasimos Th Georgopoulos, et al the foveal thickness after phacoemulsification was measured by optical coherence Tomography.[6]

In our study mean subfoveal, mean parafoveal and mean perifoveal macular thickness increased statistically significantly on day 14 postoperatively from preoperative values in both the groups. Subfoveal, parafoveal and perifoveal macular thickness in both groups returned to near normal values on day 28.

In similar study done by Vukicevic M et al on macular thickness of participants was determined using optical coherence tomography preoperatively and after surgery at 1 day, 1 week, 4 weeks and 6 months. Macular thickness increased after surgery and central foveal thickness increased by almost 7% but returned to preoperative levels after 6 months.[3]

Our study compared the effect of 2 types of cataract surgery namely MSICS and phacoemulsification on central macular thickness postoperatively.There was statistically significant increase in MSICS (group 1) as compared to Phacoemulsification (group 2) in immediate post operative period.

The result of our study correlated with the results of a Study by Ghosh, S et al (2010) which related that chance of sub-clinical increase in Central subfield macular thickness was more following Manual small incision surgery compared to phacoemulsification[7]

In this study 2 patients of 100 (2%) ,1 patient from MSICS (group 1)and 1 patient from Phaco (group 2) developed Cystoid macular edema. The pre operative central macular thickness in both the patients was normal.

In the patient in group 1 the percentage increase on day 14 in subfoveal thickness was 27.7%, in parafoveal thickness was 20.7% and in perifoveal thickness was 138.2%, and on day 28 in subfoveal thickness was 15.3 %, in parafoveal thickness was 14.6% and in perifoveal thickness was 93.7% . In the patient in group 2 the percentage increase on day 14 in subfoveal thickness was 15.4%, in parafoveal thickness was 10.1% and in perifoveal thickness was 140.9%, and on day 28 in subfoveal thickness was 14.1 %, in parafoveal thickness was 9.6% and in perifoveal thickness was 123.2% .The increase in central macular thickness was statistically significant on postoperative day 14 and day 28.

In the study by Vukicevic M et al on prevalence of optical coherence tomography-diagnosed postoperative cystoid macular oedema in patients following uncomplicated phacoemulsification cataract surgery. Cystoid macular edema was present in 5% of eyes. Findings also indicate that patients who developed postoperative cystoid macular edema had significantly thicker central foveal thickness of approximately 5% compared with those that did not.[3]

In our study phaco energy correlation with changes in central macular thickness was studied. Our study showed a statistically significant increase in central macular thickness on postoperative day 14 in group2 patients in whom more phaco energy was used intraoperatively.

Study by Cheng B et al related that the retinal thickening and macular edema can be found after uncomplicated phacoemulsification. The higher phaco power results in significant inflammation and thicker retina. The visual consequences were proportional to the degrees of macular thickening[8].

CONCLUSION:

Ocular Coherence Tomography is an important tool to detect subclinical macular edema and monitoring its progression after cataract surgery.

A preoperative macular OCT scan provides a baseline for post operative comparison.This strategy helps the clinician in efficient detection of increase in foveal thickness and macular thickness.

This study has demonstrated increase in central macular thickness in both patients undergoing uncomplicated manual small incision and uncomplicated phacoemulsification at day 14 of follow up and the central macular thickness in both groups was near normal at day 28.

This study demonstrated effect of type of cataract surgery on central macular thickness, increase in central macular thickness in immediate postoperative period was more in MSICS group as compared to Phacoemulsification group.

This study demonstrated effect of post operative non steroidal antiinflammatory on central macular thickness, increase in central macular thickness in immediate postoperative period was more in patients not on preoperative topical NSAIDs as compared to those on postoperative topical NSAIDs.

This study demonstrated that increase in central macular thickness in early postoperative period was more in patients in whom higher intraoperative phaco energy(in metrics in phacoemulsification surgery group) was used.

The incidence of substantial increase in mean macular thickness was associated with decrease of visual outcome following surgery.

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