Effect of Phaco Energy on Macular Thickness in Different Grade of Nuclear Sclerosis Diabetes Mellitus Type 2

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Abstract

Introduction: Worldwide cataract is the major cause of preventable blindness, affecting 47.8% of patients worldwide. Cystoid macular edema (CME) after cataract surgery is a common complication and reported incidence of 0.1-2.35%. The major etiology is inflammatory mediators. SD-OCT is non-invasive, objective, quantitative tool with better resolution and reproducibility during follow-up visits. The aim of present study was to find out effect of phaco-parameters used in different grades of nuclear sclerosis.

Material and Method: Group 1 has 50 diabetic type 2 and group 2 has 61 non diabetic patients as control. The inclusion criteria was Grade NS2 to NS4 by LOCS III criteria,in group 1 patients with type 2 DM with no diabetic retinopathy and group 2 with no systemic disease, Age between 45yrs to 75. Exclusion criteria were systemic disease other than type 2 DM, complicatotted cataract, grade above NS4/belowNS2 by LOCS III, past History of ocular disease, surgery, laser, intravitreal injection, drugs and eventful cataract surgery. All subjects undergone detail ocular examination. Both group 1 and 2 were undergone for macular thickness with the help of Optical Coherence Tomography Pre and post operatively on day 01,07,30,60 and on 90th day. Macular thickness Analysis by taking macular cube scan of 9x9 squares centered on the fovea, the embedded 3D-OCT program used to calculate the thickness of the macula. Distance visual acuity on Snellen's visual acuity chart, was converted to equivalent decimal value for simplification in statistical analysis.

Statistical Analysis: Statistical analysis was performed using the statistical package for social science system SPSS. Continuous variables values over time within the group were analyzed and presented as mean ± SD. Nominal categorical data between the groups were compared using the chi-square test and Fisher exact test as appropriate. $P < 0.05$ was considered statically significant.

Result: The mean central macular thickness in both groups preoperatively were 217.06 ± 17.27 μm in group 1 and 203.93 ± 12.87 μm in group 2. On postoperative day 7, central macular thickness in group 1 was 232.40 ± 16.56 μm; in group 2 was 218.67 ± 12.63 μm. On postoperative day 30 macular thickness in both groups increased subsequently 244.36 ± 18.75 μm and 224.13 ± 13.29 μm. Mean difference was found more in diabetic patients as compared to non diabetic from POD 7 and POD 30.This difference was 11.96 μm in diabetics while 5.46 μm in non-diabetics. On postoperative day 60, macular thickness in both groups subsequently decreased to 228.24 ± 16.85 μm and 214.3 ± 12.67 μm. The macular thickness on postoperative day 90 further decreased to 223.12 ± 18.48 μm in group 1 and 205 ± 12.32 μm in group 2. Mean of central macular thickness in patients with diabetes was significantly higher as compared to non-diabetics controls preoperatively as well as post-operatively and on each follow up and it is also statistically significant too.

Conclusions: The present study shows significant increase of macular thickness due to phaco energy in both groups. But increase of macular thickness doesn't affect the visual acuity postoperatively.

Keywords: Diabetes Mellitus; Cataract Surgery; Fundus Fluorescence Angiography (FFA)

Introduction

- Worldwide cataract is the major cause of preventable blindness, affecting 47.8% of patients worldwide [1,2]. Phacoemulsification and femtosecond laser surgery reduce surgical time and postoperative complications.

- Cystoid Macular edema (CME) after cataract surgery is a common complication and reported incidence of 0.1-2.35% [3]. Presence of various factors such as diabetes mellitus, uveitis, retinal vein occlusion and epiretinal membranes disrupt the blood retinal barrier, have been shown to contribute to increased rates of CME. The major etiology is inflammatory mediators that are upregulated in the aqueous and vitreous humors after surgical manipulation [3,4]. Development of CME in diabetic retinopathy cases after cataract surgery is well established but development of same in eyes without DR is still a matter of intrigue.

CME is detected with slit-lamp bio microscopy, fundus fluorescence angiography (FFA) and optical coherence tomography (OCT). SD-OCT is non-invasive, objective, quantitative tool with better resolution and reproducibility during follow-up visits. CME was defined as cystic changes with an increase in central macular thickness (CMT) of at least 20 micron on spectral domain optical coherence tomography [4].

The aim of present study was to find out effect of phaco-parameters used in different grades of nuclear sclerosis by using the torsional phacoemulsification with active fluidics technique on macular thickness in diabetics type 2.

Material and Method

The proposed prospective observational study was conducted in the department of ophthalmology of tertiary care hospital after taking Permission from ethical committee of the institute and informed consent from subjects in the study. A total of 111 eyes of 111 subjects aged between 45 and 75 years with senile cataract were divided in to 2 groups. Group 1 has 50 diabetic type 2 and group 2 has 61 non diabetic patients as control. Blood test FBS,PPBS and HbA1c done in both group.

The inclusion criteria was Grade NS2 to NS4 by LOCS III criteria, in group 1 patients with type 2 DM with no diabetic retinopathy and group 2 with no systemic disease. Exclusion criteria were systemic disease other than type 2 DM, Age below 45 and above 75, complicated cataract, grade above NS4/belowNS2 by LOCS III, past History of ocular disease, surgery, laser, intravitreal injection, drugs and eventful cataract surgery.

All subjects undergone detail ocular examination includes Visual acuity for distance with Snellen's distant visual acuity chart, Slit lamp evaluation, goldmann applanation or non contact tonometery for IOP. Grading of senile cataract done according to the lens opacities classification system III (LOCS III). Examination of the posterior segment was done with +90 D lens and indirect ophthalmoscope by using +20 D lens. All patients in group 1 and 2 were undergone for macular thickness with the help of Optical Coherence Tomography (NIDEK SD-OCT 3000RS ADVANCE) before cataract surgery and post operatively on day 01,07,30,60 and on 90th day. Macular thickness Analysis by taking macular cube scan of 9x9 squares centered on the fovea, the embedded 3D-OCT program will be used to calculate the thickness of the macula.

Both groups received same preoperative topical Moxifloxacin 0.5% one day prior to surgery and on the day of surgery Tropicamide 1%, Homide 0.5% and Flurbiproufen, 3 times in 15 minute interval. All cataract surgeries was done on Centurion vision system (Alcon laboratories USA) under local anaesthesia using a standard technique of modified chop and stop by a single surgeon. The phaco settings were same in diabetic and control group. In grade 2/3 and grade 4 cataracts phaco parameters were in table 1. Cumulative dispersive energy (CDE) value was noted in each patient at the end of surgery.

PARAMETER (maximum)	NS2/NS3	NS4
Torsional	50	60
Vacuum	350	500
Aspiration rate	32	34

Table a

Postoperatively topical eye drop used were (Moxifloxacin 0.5%) for 4 times/day for 4 weeks and (Prednisolone acetate 1%) 6 time/day for the first week followed by in tapering dose in next 4 weeks. Distance visual acuity on Snellen's visual acuity chart, slit lamp examination and SD-OCT for macular thickness was done in both groups on postoperative day 1, 7, 30, 60 and 90. Visual acuity was converted to equivalent decimal value for simplification in statistical analysis.

Statistical analysis

Statistical analysis was performed using the statistical package for social science system SPSS [Version 17.0; SPSS Inc., Chicago, IL, USA]. Continuous variables values over time within the group were analyzed and presented as mean ± SD and categorical variables are presented as absolute numbers and percentage. The comparison of normally distributed continuous variables between the groups was performed using student's test. For within the group comparison paired T-test was used to compare the significant changes at different time points from baseline values. Nominal categorical data between the groups were compared using the chi-square test and Fisher exact test as appropriate. P<0.05 was considered statically significant.

Result

A total of 111 patients were included in our study. Group I included 50 patients having type 2 diabetes mellitus and group II included 61 non-diabetic patients, out of the total 111 patients, there were 23 males and 27 females in Group 1 and there were 31 males and 30 females in Group 2. This difference in the sex was found to be statistically in significant with a p Value of 0.656. Majority of patients the grade of cataract was NS3 (42.0%) followed by NS4 (36.0%) and NS2 (22.0%) in group 1 while in majority of patients the grade of cataract was NS3 (34.4%) and NS2 (34.4%) followed by NS4 (31.1%) in group 2. The mean central macular thickness in both groups preoperatively were 217.06 ± 17.27 μm in group 1 and 203.93 ± 12.87 μm in group 2. On postoperative day 7, central macular thickness in group 1 was 232.40 ± 16.56 μm; in group 2 was 218.67 ± 12.63 μm. On postoperative day 30 macular thickness in both groups increased subsequently 244.36 ± 18.75 μm and 224.13 ± 13.29 μm. Mean difference was found more in diabetic patients as compared to non diabetic from POD 7 and POD 30. This difference was 11.96 μm in diabetics while 5.46 μm in non-diabetics. On postoperative day 60, macular thickness in both groups subsequently decreased to 228.24 ± 16.85 μm and 214.3 ± 12.67 μm. The macular thickness on postoperative day 90 further decreased to 223.12 ± 18.48 μm in group 1 and 205 ± 12.32 μm in group 2. The mean macular thickness were decreases more in diabetic then non-diabetic from POD 30 and POD 60. This difference was 16.12 μm in diabetics while 9.77 μm in non-diabetics. Mean of central macular thickness in patients with diabetes was significantly higher as compared to non-diabetics controls preoperatively as well as post-operatively and on each follow up and it is also statistically significant too. Mean macular thickness was reached maximum on POD 30 in both groups. Mean CDE was found to be significant in both group according to grade but mean CDE was lower in non-diabetic patients as compared to diabetics but the difference was not found to be statistically significant. Figure 1 shows the comparison of mean macular thickness among two groups in different grade of cataract. It was found that the mean macular thickness was higher in patients in group 1 as compared to group 2 in all the grades but only the difference in grade NS2 and NS4 was found to be statistically significant. Figure 2 shows the comparison of mean macular thickness on POD 7 among two groups in different grade of cataract. It was found that the mean macular thickness was higher in patients in group 1 as compared to group 2 in all the grades but only the difference in grade NS2 and NS4 was found to be statistically significant. Macular thickness increases from 222.28 to 239.28 μm in group 1 and 205.33 to 221.14 μm. Figure 3 shows the comparison of mean macular thickness on POD 30 among two groups in different grade of cataract. It was found that the mean macular thickness was higher in patients in group 1 as compared to group 2 in all the grades and this difference was also found to be statistically significant. Figure 4 shows the comparison of mean macular thickness on POD 60 among two groups in different grade of cataract. It was found that the mean macular thickness was higher in patients in group 1 as compared to group 2 in all the grades but only the difference in grade NS2 and NS4 was found to be statistically significant.
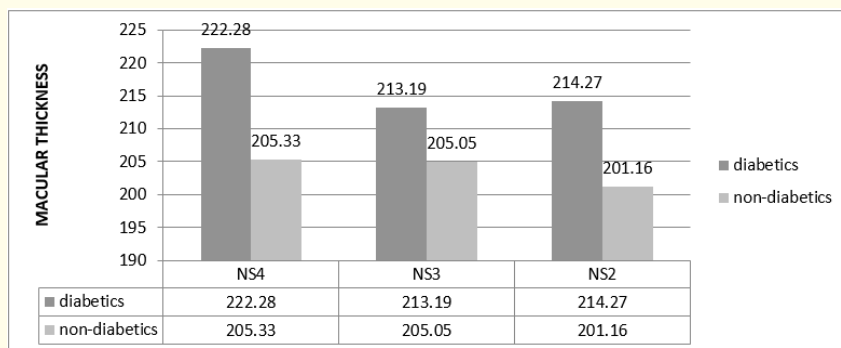

	NS4	NS3	NS2
diabetics	222.28	213.19	214.27
non-diabetics	205.33	205.05	201.16

Figure 1: Comparison of Pre-op Macular thickness among diabetics and no diabetics in different grades of cataract.
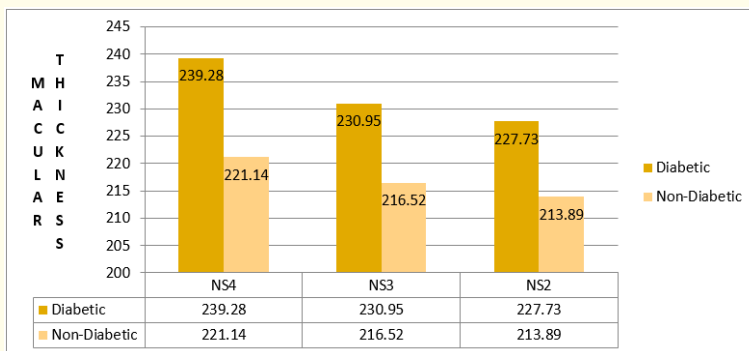
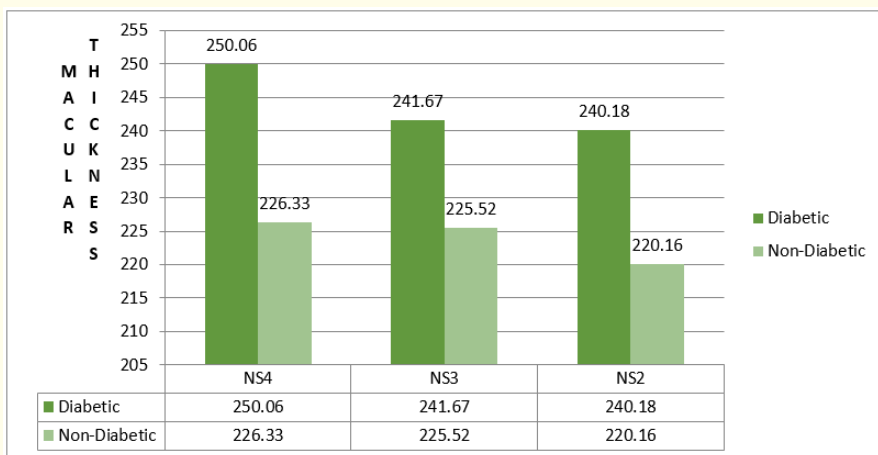**Figure 2:** Comparison of mean macular thickness among two group in different grades of cataract POD7.

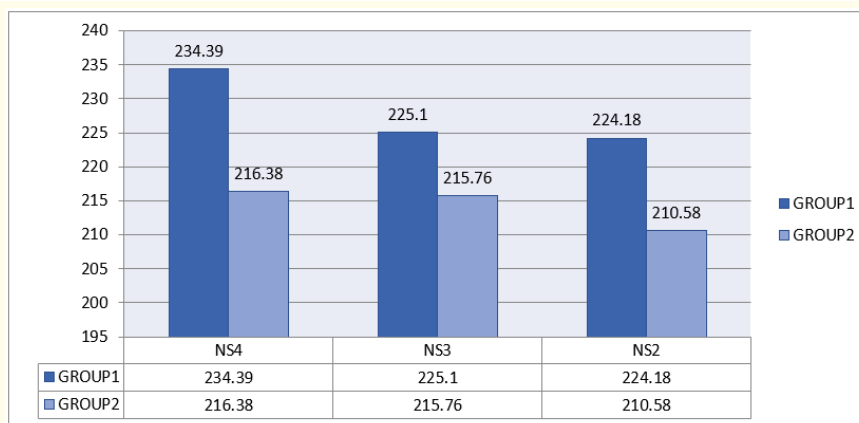**Figure 3:** Comparison of POD30 Macular thickness among two group in different grades of cataract.

Figure 4: Comparison of POD 60 Macular thickness among two group in different grades of cataract.

Figure 5 shows the comparison of mean macular thickness on POD 90 among two groups in different grade of cataract. It was found that the mean macular thickness was higher in patients in group 1 as compared to group 2 in all the grades and the difference was also found to be statistically significant.

Table 4 show comparison of visual acuity in LogMAR on respective postoperative day. visual acuity was statistically insignificant between two groups on respective follow up days.
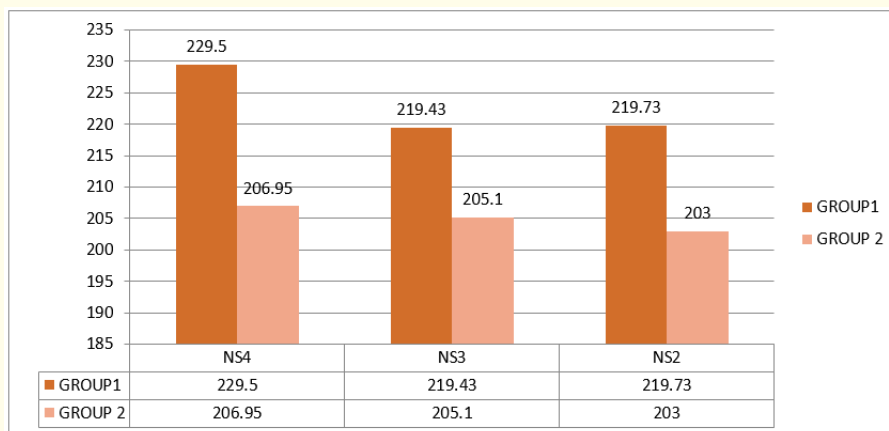

	NS4	NS3	NS2
GROUP1	229.5	219.43	219.73
GROUP 2	206.95	205.1	203

Figure 5: Comparison of POD 90 Macular thickness among two group in different grades of cataract

Table 1: Demographic profile.

Parameters		Group 1	Group 2
Sample size		50	61
Gender (M/F)		(23/27)	(31/30)
Mean age		60.76 ± 6.27 years	61.28 ± 6.50 years
Grade of cataract	Ns2	11(22.0%)	19(34.4%)
	NS3	21(42.0%)	21(34.4%)
	NS4	18(36.0%)	21(31.1%)

Table 2: Mean macular thickness (μm) between groups 1 (diabetics) and 2 (control) in pre-op and postoperative days.

Time	Group 1		Group 2		p Value*
	Mean	SD	Mean	SD	
Pre-OP	217.06	17.27	203.93	12.87	0.001
POD 7	232.40	16.56	218.67	12.63	0.001
POD 30	244.36	18.75	224.13	13.29	0.001
POD 60	228.24	16.85	214.36	12.67	0.001
POD 90	223.12	18.48	205.08	12.32	0.001
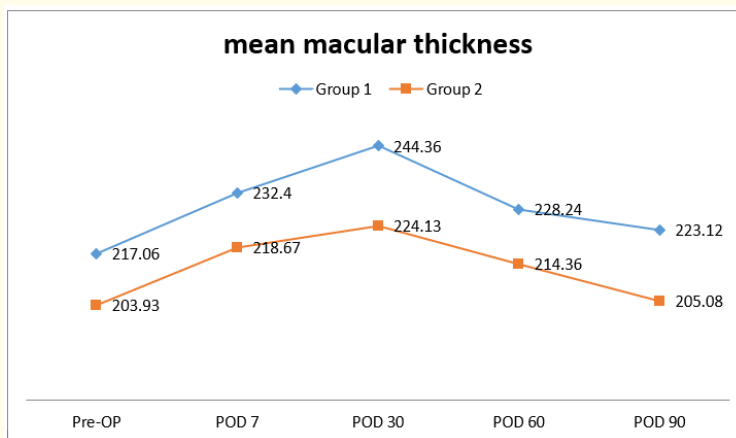
Graph 1: Mean macular thickness in both group.
Showing mean maclar thickness (µm) was maximum at pod 30 and decreased by pod 90.

Table 3: Comparison of mean CDE among different grade of cataract in same group.

Parameter	NS2	NS3	NS4	P value*
	MeanSD	MeanSD	MeanSD	
Group 1	5.471.19	9.314 1.25	16.5611.86	<0.001
Group 2	5.172 1.19	8.886 1.406	16.352.05	

*Ordinary one way ANNOVA.

Table 4: Visual acuity in LogMAR in group 1 and 2 on postoperative days.

LogMAR	Group 1	Group 2	P value
POD7	0.160.1	0.150.11	0.58
POD30	0.120.07	0.130.09	0.52
POD 60	0.100.06	0.090.05	0.34
POD 90	0.080.04	0.070.04	0.19

Discussion

The objective of this study also the effect of phaco energy on macular thickness in diabetics and non-diabetics. Cumulative dissipated energy (CDE) is a phacoemulsification unit parameter designed to monitor the amount of energy delivered during phacoemulsification. In our study patient with NS4 grade both in diabetic and non-diabetic had maximum macular thickness in all follow up periods as compare to NS3, NS2.NS4 had maximum CDE among these. NS2, NS3 had also shown increase in macular thickness which was more in NS3.So in our study CDE has positive correlation with macular thickness, higher the CDE higher the macula thickness [5,6]. Our results were supported by Joel M. Perez., et al.

[7] and Anastasilakis K., et al. [8] as both found direct association of the CDE with macular thickness. Since CDE equates to amount of phacoemulsification power or duration of surgery which result in more damage to ocular tissue, it is hypothesized that an increased CDE may result in a higher or longer release of inflammatory factors, thus thicker foveal thickness after surgery.

As we found in our study that diabetic patients has statistically significant increase in macular thickness but it did not affect the visual acuity Stunf Pukl S., et al. [9] additionally evaluated retinal sensitivity by Microperimertry in diabetic patients after cataract surgery. Microperimetry added to visual acuity and thickness measurements shows supplementary macular function, especially of

value in patients at risk for macular changes. They found increase in the central 5-field area of macular thickness and a corresponding decrease in retinal sensitivity in diabetic patients without diabetic retinopathy 6 months after cataract surgery. This shows that increase in macular thickness, however not affect the visual acuity but can affect the retinal sensitivity.

Conclusions

The present study shows significant increase of macular thickness due to phaco energy in both groups. But increase of macular thickness doesn't affect the visual acuity postoperatively.

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