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Macular Thickness Assessment Using OCT in Type 2 Diabetic Patients Undergoing Cataract Surgery

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Abstract

Keywords: OCT, Clinically significant cystoid macular edema (CSME),Macular thickness

Introduction

Macular edema is a common cause of unfavourable visual outcomes after cataract surgery. Clinically significant cystoid macular edema (CSME) has a reported incidence of 1% to 2% after cataract surgery [1].

Diabetes has been noted with an increased incidence of postoperative changes in macular thickness. The incidence of macular edema on optical coherence tomography (OCT) was 22% in diabetic eyes undergoing cataract surgery [2]. The macular thickness variations after cataract surgery in diabetic patients could be caused by the cataract surgery or diabetes itself, but it might be difficult to differentiate between these two causes.

OCT has been shown to be highly efficient in measuring macular thickness in normal individuals and diabetic patients [3,4]. For detecting macular edema, OCT is superior to contact lens bio microscopy and fluorescein angiography (FFA) [5]. OCT can assess and can detect subtle changes of macular thickness. In a previous report, diabetic eyes with CSME at the time of cataract surgery showed persistent CSME throughout the first postoperative year and showed no tendency to resolve spontaneously [6]. For diabetic eyes without CSME at the time of cataract surgery, macular edema after cataract surgery resolved spontaneously in 50% of cases by 6 months and in 75% of cases by 1 year.

In this study, using OCT we assessed the changes of macular thickness after cataract surgery in diabetics.

Aims And Objectives:

To determine changes in macular thickness following cataract surgery in diabetics.

To elucidate the pre-op and post-op optical tomographic features of after cataract surgery in diabetics.

Materials And Methods:

It is a Prospective hospital-based study which included 100 diabetic patients undergoing cataract surgery who were visited to the hospital. The study was conducted between March 2021 to March 2022 at Mahatme Eye Bank Eye Hospital Nagpur Maharashtra.

Inclusion Criteria:

1. Patients able to give consent and willing for follow up
2. Known case of Diabetes including non-proliferative diabetic retinopathy patients
3. Patients undergoing Small incision cataract surgery
4. Patients with Senile cataract

5. No previous eye surgery

Exclusion Criteria:

1. History of previous eye surgery (vitreous, retina and glaucoma)
2. Intra operative complications
3. Proliferative diabetic retinopathy
4. History of diabetic macular edema (DME, CSME)
5. Presence of choroidal or retinal disease that can affect retinal thickness except diabetic retinopathy
6. Uveitis
7. Intravitreal injection and retinal lasers
8. Mature, Traumatic, Complicated Cataract
9. Patients with lost to follow up

Methodology

Demographic data of patients was collected including name, age, sex, occupation and personal details. Ophthalmologic examination which includes best-corrected visual acuity (BCVA) (using Snellen's chart & Log MAR charts), slit lamp bio microscopy, assessment of the retina by indirect ophthalmoscopy and OCT was performed. Log MAR charts are used in this study for recording visual acuity as these charts have become the gold standard method for recording visual acuity in clinical studies. Visual acuity with Snellen chart at 6 meters (6/6), at 20 feet (20/20), 1.0 vision in decimal charts and 0.0 log MAR are considered equivalent.

Routine tests: CBC, ECG, RBS, BP, and pre-anaesthetic check-up in all cases was done. If any comorbid conditions are found they will be managed before surgery after consultation from a concerned specialist and proper precautions were taken before, during and after surgery. Anticoagulants if any was stopped 5 days before surgery

Patients had received standard post-operative care. Patient follow up was done on the first postoperative week, 4 week and 3 months. During follow up patients were subjected to visual acuity testing, anterior segment examination under slit lamp and posterior segment examination under indirect ophthalmoscope along with OCT. Every time OCT findings were noted. Final status of the eye including uncorrected and best corrected visual acuity was noted. The baseline macular thickness 170-240 um was considered normal in the present study.

Statistical analysis: Data will be entered into Microsoft excel data sheet and will be analysed using SPSS 22 version software. Descriptive statistics, including mean and standard deviation were calculated for each group. Fisher's exact two-tailed test & ANOVA was used for analysis of data on a nominal scale. A p-value less than 0.05 was considered statistically significant.

Results:

The demographical data includes age, sex of the patients, laterality, type of surgery, duration of problem, pre-treatment and post treatment BCVA, macular thickness. The minimum follows up period was 6 months. Patients included in this study were subjected to FFA, OCT at the time of presentation and also at first and second review after 1 and 2 months respectively.

100 patients were included in this study. Of these 42 were male patients and 58 were female patients

Table no 1. Distribution of patients according to gender

Gender	No. of Patients	percentage
Male	**42**	**42%**
Female	**58**	**58%**

Volume 5, Issue 3; May-June 2022; Page No 1308-1316

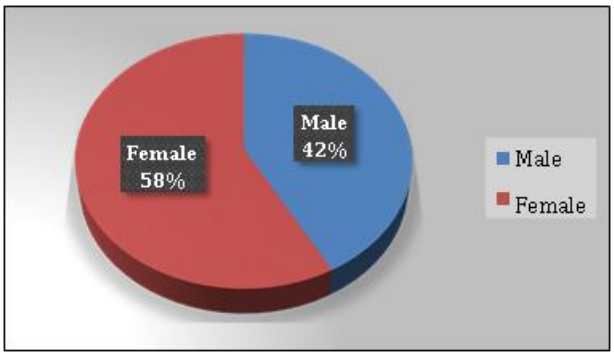


Table no 2. Distribution of patients according to age

Age	No. of Patients	percentage
<= 40	1	1%
41 – 50	10	10%
51 – 60	34	34%
>60	55	55%

The age of the patients ranged from 40 to 75 years (mean age of the patients 61.12 ± 8.02 years)

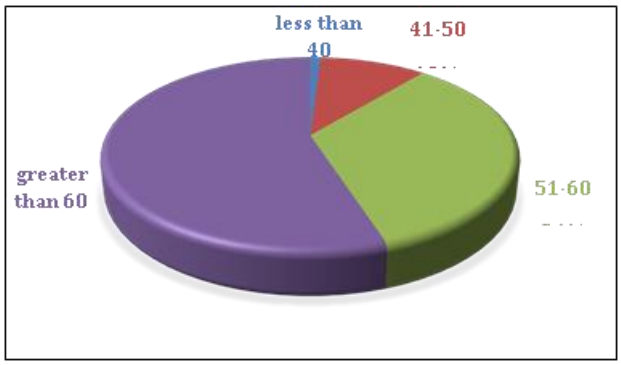


Table no 3. Distribution of patients according to laterality of eye

laterality	No. of Patients	percentage
Right eye	50	50%
Left eye	50	50%

Volume 5, Issue 3; May-June 2022; Page No 1308-1316

Table no 4. Distribution of patients based on associated systemic illness

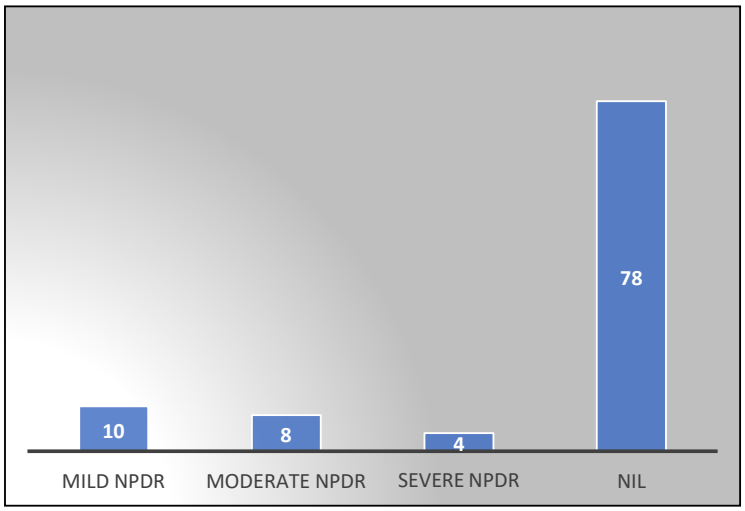
Associated systemic illness	No. of Patients	percentage
Hypertension	39	39%
Dyslipidaemia	4	4%
Nil	57	57%

The right eye was operated on in 50 of the 100 patients while the left eye was operated on in the other 50 patients. 57 of the 100 patients did not have any systemic illness. 39 patients suffered from hypertension, 4 from dyslipidaemia.

Table 5. Distribution of eyes in patients with diabetes mellitus by DR classification*

Retinopathy	No. of Patients	percentage
Mild NPDR	10	10%
Moderate NPDR	8	8%
Severe NPDR	4	4%
No retinopathy	78	78%

78 of 100 patients were found with no signs of retinopathy pre-operatively, 10 patients detected with mild NPDR, 8 patients with moderate NPDR, 4 patients with severe NPDR.



Volume 5, Issue 3; May-June 2022; Page No 1308-1316

Table no 6. Distribution of eyes of patients by VA (log MAR)

VA (log Mar)	Preop VA (no. of patients)	Post op (final) VA
1.0 (6/6)	0	4
0.66 (6/9)	1	43
0.5 (6/12)	11	38
0.33 (6/18)	13	10
0.2 (6/24)	24	4
0.17 (6/36)	19	0
0.1 (6/60)	27	1

In the 100 patients, the mean pre–operative visual acuity was 0.24 ± 0.13 decimals (approximately 6/24) while the mean postoperative visual acuity was 0.56 ± 0.16 decimals (approximately 6/12) (Fig. 6); this difference was statistically significant (P <0.05) [df = 99]

Table no 7. Distribution of eyes of patients based on OCT Findings central Macular Thickness

Macular thickness (µm)	Number of patients			
	Preop	Post op 1week	post op 4weeks	Post op 3months
<= 200	88	89	88	88
201 – 300	12	11	12	11
301 – 400	00	00	00	00
>400	00	00	00	01

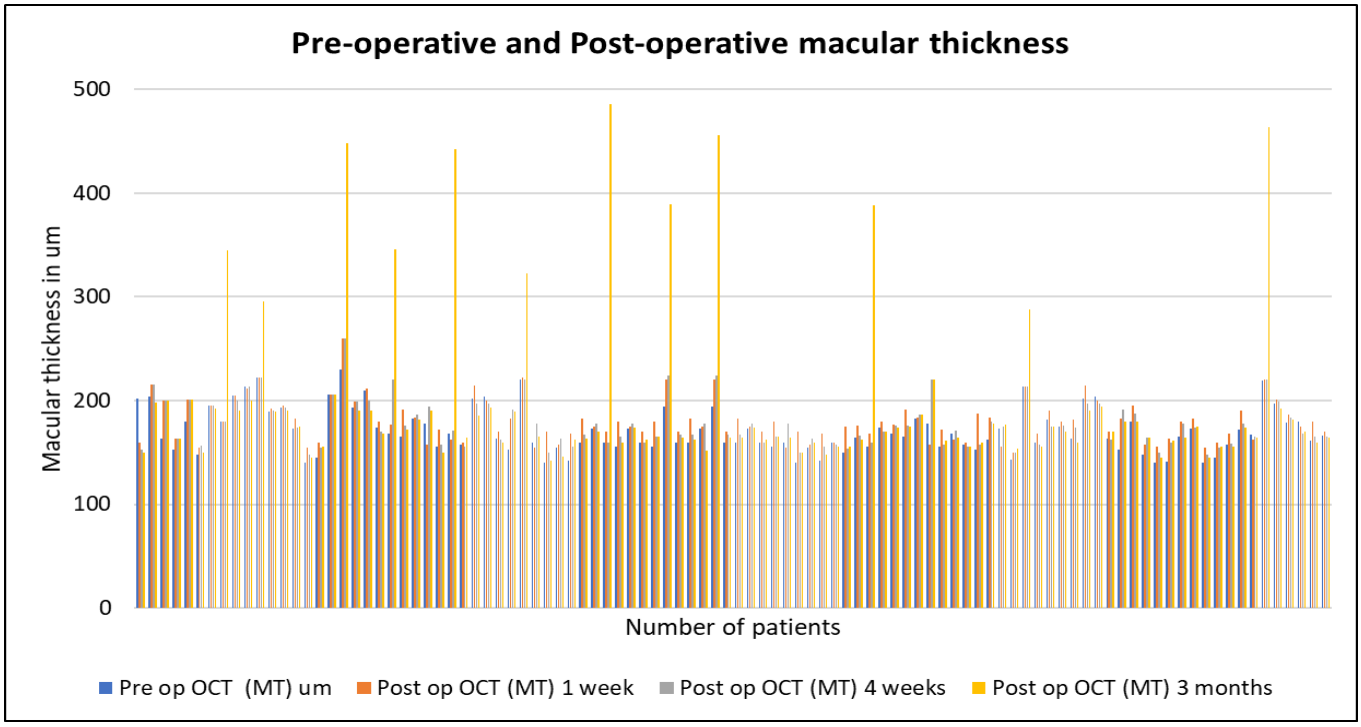
Macular thickness in the operated eyes of 100 patients who underwent cataract surgery, the mean pre- operative macular thickness noted was 170±20µ.

Post operatively the following changes were noted:

1. at first week, mean macular thickness noted was 177±16µ.
2. at four weeks, mean macular thickness noted was 180±27µ.
3. at 3 months, mean macular thickness noted was 179±25 µ.

Statistical analysis of the differences between the 4 mean values (pre-operative, postoperative 1st, 4th weeks and post-operative 3rd month) was done by one-way analysis of variance (ANOVA); the differences were found to be statistically significant (Fisher `f' value= 4.10; P=0.007(p=<0.05))

Volume 5, Issue 3; May-June 2022; Page No 1308-1316



Discussion:

Cataract development may be accelerated as a result of the retinal disease process or as a sequela of corticosteroid treatment, as in diabetic retinopathy [7].

The conclusions of studies on the development of DR and DME after cataract surgery are controversial.

Other studies suggest that the development of DR and DME after cataract surgery is part of the natural history of the disease and that cataract surgery does not cause the progression of diabetic retinopathy [8, 9].

Although this question remains unanswered, it has been indicated in many studies that macular thickness increases after cataract surgery [10–12].

Macular edema after cataract surgery in diabetic patients could be caused by the cataract surgery (Irvine- Gass syndrome) or diabetes itself. Following cataract surgery, subclinical changes may occur in macular thickness without the visual acuity being affected. Most of the macular edema after cataract surgery resolves spontaneously by 6 months, but diabetic macular edema tends to persist [13,14]. Therefore, it is recommended that laser therapy for macular edema be deferred until 6 months after surgery to permit resolution of the Irvine-Gass element [14].

Dowler et al. [6] reported that CSME arising after surgery commonly resolved, particularly if retinopathy was mild.

Cong et al. [15] summarized the possible mechanisms of macular thickness changes after cataract surgery, and the mechanisms included the release of local inflammatory mediators caused by surgical stimulation, tissue damage caused by ultrasound energy and radiation effects, surgical perfusion fluid damage, and light exposure. Although the loss of pericytes, endothelial cells, and hemodynamic abnormalities in diabetic patients can also cause postoperative macular thickness increase and even macular edema.

Regarding the risk factors for cataract formation in patients with diabetes, the rate of cataract formation has been reported to be influenced by age [16, 17, 18], severity of preoperative DR [16, 19, 20, 21], and other factors [16, 19, 22]. Klein et al reported that women had a higher rate of cataract extraction than men [16], age more than 65 years, certain comorbidities like hyper tension has higher risk of NPDR development in patients with diabetes who underwent cataract surgery [23] which is similar to our study.

In an Israeli cohort [24], Korean study [25] diabetes and hyperlipidaemia were found to be independently

Volume 5, Issue 3; May-June 2022; Page No 1308-1316

related to a higher incidence of cataract formation [24]; the results were consistent with our study.

In the studies by Polito et al [26] and Danis et al [27], the `fast macular thickness' map protocol was used widely in measuring the macular thickness, which provided good repeatability and reproducibility. In the present investigation, the `fast macular thickness' map protocol was used for measuring macular thickness.

Studies like Kurt and Kilic [28]; Zhao et al. [29]; Jurecka et al. [30]; showed a decrease in MT on the first postoperative day, increases at week 1 and months 1 and 3, and a relative decrease at month 6, although MT did not return to preoperative levels.

Studies like Biro et al. [31]; Lobo et al. [32] reported that there were no significant changes in thickness at day one. However significant increase in thickness where detected on the 7th, 30th and 60th days, retinal thickness reached a maximum at 6 weeks.

Other studies measured MT by OCT preoperatively and at 1, 6, 15, 30, 60, 90, and 360 days after surgery and found that MT increased significantly from day 30 after surgery in diabetic patients, reaching its maximum thickness at day 60 [33,34,35].

Von jogow et al. [36] used standardized OCT to find subclinical changes in macular thickness postoperatively. Mean foveal thickness (MFT) was increased significantly at day one. After cataract surgery a mild increase of foveal thickness was noted which, however, did not impact visual acuity contrary to our study where visual acuity was found to fall in 3% of patients.

In our study, macular thickness was increased in 5% of eyes with peak incidence was at 1-month post-surgery, out of 3% patients; 2% patients with diabetic retinopathy were found to have increased macular thickness at 3 months postoperatively which was similar to almost maximum studies. In this given study, it has been proved that small incision cataract surgery (SICS) has no negative impact on macular thickness in diabetic patient. Therefore, in poor countries diabetic patients can undergo SICS.

We presumed that early postoperative macular edema is due mostly to the Irvine-Gass component

Conclusion:

Subclinical macular edema occurs after uncomplicated cataract surgery with a peak at 1 week after surgery and can last for up to 4 weeks. OCT showed macular edema without altering the architecture of the macula. OCT with its high-resolution imaging of retina helps in the diagnosis and follow-up of post operative cystoid macular edema. OCT is a non-invasive technique (unlike FFA) to detect subtle cystoid spaces which may be difficult to detect clinically. OCT objectively monitors the course of post operative cystoid macular edema till its resolution.

In conclusion, this study demonstrated that 8% of diabetic patients developed increases in CSMT > 23% after cataract surgery. Its peak incidence was at 1- and 3-months post-surgery and it resolved spontaneously by 6 months post-surgery on proper follow up. It has been concluded from the study that small or large incision cataract surgery did not affect CSMT in diabetic patients. This suggests that macular edema after cataract surgery in diabetic patients could be managed conservatively because it is likely to improve without treatment by 6 months post-surgery. Visual acuity was reduced in 3% eyes an effect of this edema.

One of the limitations of the present study was the relatively short post-operative duration over which patients came for review. An important reason for this was that, in the absence of notable complications, patients felt it was not necessary to present for review. It is possible that if the follow-up period had been longer, the results may have been different.

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Volume 5, Issue 3; May-June 2022; Page No 1308-1316

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Volume 5, Issue 3; May-June 2022; Page No 1308-1316

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Volume 5, Issue 3; May-June 2022; Page No 1308-1316