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## Original Research Article

# A comparative study of macular thickness measurements using spectral domain-optical coherence tomography before and after cataract surgery in patients with diabetes mellitus and their age matched controls

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## ABSTRACT

**Background:** Patients with diabetes mellitus who undergo cataract surgery can be prone for macular edema post-operatively. Aim of this study was to compare macular thickness in diabetics and non-diabetics, pre and post cataract surgery using SD-OCT.

**Materials and Methods:** A Cohort study of 50 diabetic and 50 non-diabetic cataract patients who presented to ophthalmology out patient department, aged 50–70 years underwent macular thickness assessment using SD-OCT pre and post cataract surgery.

**Results:** The macular thickness showed a steady increase with time in non-diabetics and diabetics seen at baseline, 1 week post operative and 6 weeks post op. But the mean difference in diabetics was higher with a statistical significance ( $p < 0.05$ ).

**Conclusion:** OCT is a noninvasive investigation which can differentiate between diabetic macular edema and postoperative cystoid macular edema. Preoperative assessment of macular thickness will be useful in the management of macular edema in both conditions, thus improving visual prognosis post cataract surgery.

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## 1. Introduction

Cataract surgery can have several vision-threatening complications, postoperatively, despite being a common outpatient procedure. After cataract surgery, clinically significant cystoid macular edema (CME) has been found to have an incidence of 1% to 2%.<sup>1</sup> Macular edema (ME) contributes to a significant amount of visual loss in patients post cataract surgery. Edema within one-disc diameter of the center of the macula was found in about 9% of patients with diabetes mellitus, out of whom 40% had central macular involvement.<sup>2</sup>

Cystoid macular edema (CME) is defined as the presence of macular edema after cataract surgery. It is also called

as pseudophakic edema or the “Irvine-Gass syndrome”. Although, commonly seen after a complicated cataract case, it can also be found following routine uncomplicated cataract surgery. Visual recovery is delayed in cases of CME post cataract surgery, but the prognosis is good. However, some patients experience chronic cystic alterations in the macula, with permanent visual loss subsequently.<sup>3</sup>

Optical coherence tomography (OCT) is a non-contact, non-invasive technique for in vivo imaging of the human retina.<sup>4</sup> It is a method for high-resolution cross-sectional imaging, used to measure retina thickness. The principle of the OCT is based on the usage of light to detect relative changes in reflection at optical interfaces. With a theoretical axial resolution of 10 to 14 microns, OCT has been considered an effective means of detecting postsurgical

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CME.<sup>5</sup>

Spectral Domain Optical coherence tomography was used to evaluate macular edema, which is defined as an increase of macular thickness > 30% from the baseline. In diabetic patients, the macular oedema could be caused either by the cataract surgery (Irvine-Gass syndrome) or diabetes itself. Generally, spontaneous resolution of macular edema after cataract surgery occurs within 6 months, but diabetic macular edema may continue to persist.<sup>6</sup>

Inflammatory mediators cause a breakdown of the blood-retinal barrier in both healthy persons and in diabetic patients. The levels of vascular endothelial growth factor (VEGF) and other inflammatory cytokines are increased in diabetic eyes that have undergone surgical trauma and subsequent inflammation post cataract surgery. These factors not only compromise the retinal vasculature but also its ability to recover after surgery thus leading to macular edema.<sup>4</sup>

OCT is an established ophthalmic diagnostic tool, particularly for macular and vitreoretinal interface diseases such as age-related macular degeneration, macular hole and diabetic retinopathy.<sup>7–10</sup>

Subclinical CME and retinal leakage are seen even after uneventful cataract surgery. These subclinical changes in macular thickness after cataract surgery are easily detected on OCT.<sup>11</sup>

Through this study we aim to determine if macular thickness in diabetic patients without the presence of any diabetic retinopathy changes, plays a significant role in the development of Irvine Gass syndrome as opposed to non-diabetic patients.

### 1.1. Purpose

To compare the macular thickness in patients with diabetes and non-diabetic patients before and after cataract surgery.

## 2. Materials and Methods

The study was conducted at the Department of Ophthalmology, Adichunchanagiri Institute of Medical Sciences. The study participants signed an informed consent preoperatively. Our type of study was a cohort study with age matched controls. Patients aged between the ages of 50 – 70 years who presented with cataract to the ophthalmology OPD in our hospital were the subjects. Among them those patients with type 2 Diabetes Mellitus and a relatively normal fundus preoperatively who underwent a relatively uncomplicated cataract surgery, were categorized as group A. Those patients without type 2 Diabetes Mellitus and a relatively normal fundus preoperatively who underwent a relatively uncomplicated cataract surgery, were categorized as group B.

### 2.1. Exclusion criteria

1. Known cases of Diabetic retinopathy.
2. Pre-existing cases of glaucoma.
3. Patients who had undergone prior pan-retinal photocoagulation
4. Patients who had active inflammation of eye i.e anterior / posterior uveitis.
5. Complicated cataract surgery i.e. loss of vitreous, Posterior Capsular rent, aphakia.
6. Known vascular occlusions i.e. Central Retinal Vein Occlusion, Central Retinal Artery Occlusion, Branch Retinal Vein Occlusion, Branch Retinal Artery Occlusion.
7. Age related macular degeneration changes in retina.

Patients from both the groups underwent assessment of macular thickness using SD – OCT (Spectral domain optical coherence tomography) prior to cataract surgery. Subsequent assessment of macular thickness after Cataract surgery at 1 week Post-op and at the end of 6 weeks post op was done. Both the groups were compared by analyzing the results using Paired t test and repeated measure ANOVA.

## 3. Results

Considering the diabetic patients i.e Group A, their mean age was 65.78 years. Pre op macular thickness was 231.26 microns. Macular thickness at 1 week post op was 249.42 microns. Macular thickness at 6 weeks post op was 263.16 microns.

Considering the non-diabetic patients i.e Group B, their mean age was 66.44 years. Pre op macular thickness was 203.92 microns. Macular thickness at 1 week post op was 213.62 microns. Macular thickness at 6 weeks post op was 224.56 microns.

When we analyzed the results for the diabetic patients, i.e group A, we found that the difference in macular thickness seen at baseline, post op 1<sup>st</sup> week, 6<sup>th</sup> week was statistically significant with a p value of <0.05. The analysis of the results for the non-diabetic patients, i.e group B, showed that the difference in macular thickness seen at baseline, 1<sup>st</sup> week, 6<sup>th</sup> week was statistically significant with a p value of <0.05.

There was a steady increase in the mean macular thickness seen at baseline, 1<sup>st</sup> week, 6<sup>th</sup> week in diabetic patients as well as non-diabetic patients. But the increase in macular thickness seen among diabetics was comparatively higher with a statistically significant difference.

Table 1:

	Group A	Group B
Number of patients	50	50

**Table 2:**

	<b>Group A</b>	<b>Group B</b>
<b>Age</b>	50-70 (65.78)	50-70(66.44)

**Table 3:** Comparing ages

	<b>Mean Age</b>	<b>Standard Deviation</b>
<b>Group A (with DM)</b>	65.78	5.300
<b>Group B (without DM)</b>	66.44	7.304

**Table 4:** Subjects with diabetes mellitus (Group A)

	<b>Mean macular thickness</b>	<b>Standard Deviation</b>
Pre op	231.20	37.579
1 wk post op	249.42	37.641
6 wks post op	263.16	37.790

**Table 5:** Subjects without diabetes mellitus (Group B)

	<b>Mean macular thickness</b>	<b>Standard Deviation</b>
Pre op	203.92	21.755
1 wk post op	213.62	21.007
6 wks post op	224.56	21.166

#### 4. Discussion

Diabetic mellitus is one of the common metabolic disorders which affects various organs in the body. Likewise, effects of diabetic retinopathy and macular involvement is well studied.<sup>12</sup>

It has been found that incidence of CME (affecting visual outcome) after small-incision uneventful cataract surgery is between 0% and 9%, incidence of angiographic leakage following uneventful cataract is found to be between 9.1% and 20.4%.<sup>8</sup>

Macular edema has many complex mechanisms and diabetes significantly impacts the macula. A few factors that can exaggerate the macular edema include Mean HbA1C, duration of diabetes, type of diabetes, use of insulin, presence of other co-morbidities such as diabetic nephropathy, hypertension, anemia; poor diet, poor metabolic control.<sup>13</sup>

The incidence of post operative CME is more in cases of intraoperative vitreous loss, presence of uveitis, posterior capsulotomy, type of IOL implantation. Surgical technique also has an impact on post operative CME. In a study done by Rosetti et al, the patients who underwent phacoemulsification had less incidence of CME compared to those who underwent ECCE. The closed nature of phacoemulsification surgery offers the advantage of ensuring that the vitreous body is contained following posterior capsule rupture, thus minimizing traction on the vitreomacular interface and thereby reducing the CME.<sup>9</sup>

In a study by Gulkilik et al, it was found that post operative inflammation and association with iris trauma may be risk factors for development of post operative CMO. It was also reported that the development of complete posterior vitreous detachment provides a protective effect against development of CME.<sup>10</sup>

OCT is an easy, non-invasive method to measure the thickness of macula in various quadrants. In our study, the group with diabetes mellitus and the control group were subjected to OCT pre-operatively, mature and hypermature cataracts were excluded as it would be difficult to document the macular thickness by OCT. All the surgeries, of both groups were performed by the same surgeon to avoid inter person variability and all the subjects in both groups underwent manual small incision cataract surgery.

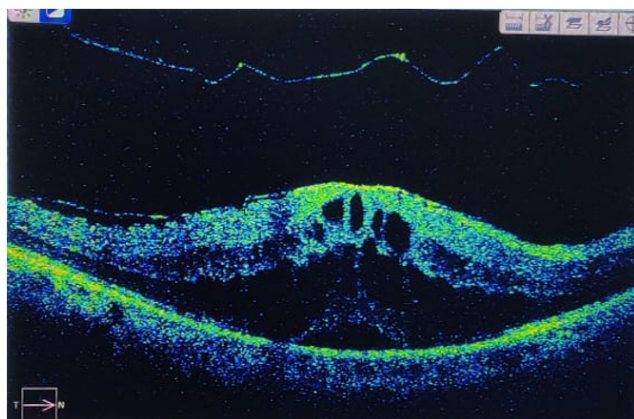
In our study, we aimed to evaluate and compare macular thickness changes after cataract surgery between normal and diabetic patients (with type 2 diabetes) without retinopathy, using OCT. We assessed the macular thickness with OCT preoperatively, and at weeks 1 and 6 postoperatively and we compared the measurements of the two study groups. It was found that although there was a steady increase in macular thickness in healthy controls as well as in controlled diabetics without DR, postoperatively compared to the preoperative values, the increase in macular thickness seen among diabetics was comparatively higher with a statistically significant difference.

A study was conducted by Brahm Prakash et al, where the macular thickness was assessed with OCT preoperatively, and at weeks 1 and 6 postoperatively, and comparisons were made between the measurements of both the two study groups. In their study, the macular thickness in healthy controls as well as in controlled diabetics without DR had increased significantly at the end of the first and sixth weeks postoperatively compared to the preoperative results. In both groups, this thickening persisted until six weeks postoperatively in all subjects and did not regress to preoperative levels till the last follow-up at six weeks. This study demonstrated that the influence of uncomplicated cataract surgery on macular thickness in well-controlled diabetic patients without DR and nondiabetic patients showed similar intragroup thickening. But the intergroup comparison was not statistically significant.

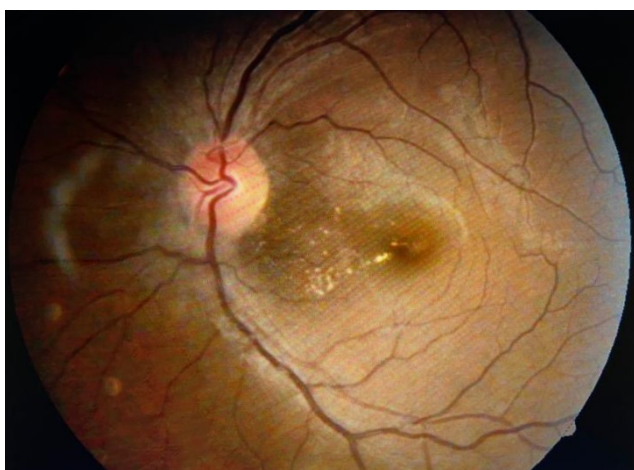
In a study done by Kim et al, Diabetic eyes have a high incidence of increased center point thickness on OCT post cataract surgery, associated with a loss of vision at 1 month, with limited visual recovery at 3 months.<sup>5</sup>

In a contrast study done by Henricsson et al, only 2 of the 70 diabetic patients who underwent cataract surgery developed macular edema. Both of these patients had a history of diabetic retinopathy changes.<sup>14</sup>

Gupta A et al found that post operative macular edema in patients with diabetes mellitus, who underwent cataract surgery, resolved spontaneously in patients with no or



**Fig. 2:** OCT picture of a non-diabetic patient with macular oedema and associated posterior vitreous detachment



**Fig. 3:** Fundus photograph showing macular oedema

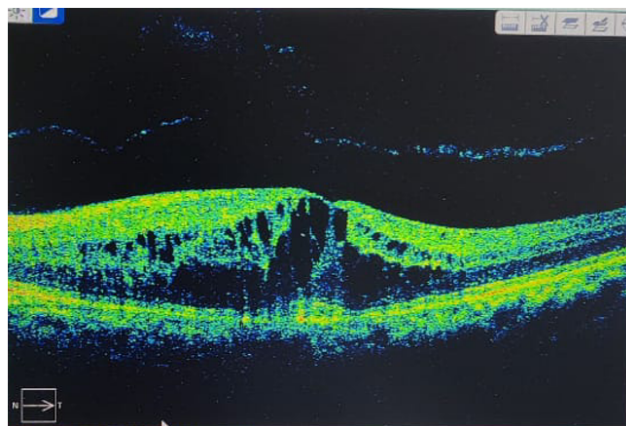
minimal diabetic retinopathy.

All diabetic patients need to be observed for at least 6 months post cataract surgery to intervene with laser photocoagulation as and when required. This will prevent visual loss from diabetic maculopathy and other consequences of diabetic retinopathy.<sup>15</sup>

In a study done by Pollack A et al with a sample size of 44 eyes, in about 50% of eyes, CME was observed 6 weeks after surgery and in 25% at the end of 1 year. The preoperative presence of diabetic retinopathy had a significant effect on the onset and persistence of CME. CME was reported to be found in only 32% of eyes without pre-existing diabetic retinopathy and in 81% of eyes with pre-existing diabetic retinopathy ( $p < 0.05$ ). They concluded that Angiographic CME (detected only on fluorescein angiography) was more common than clinical CME (detected on ophthalmoscopic examination) in eyes with no pre-existing diabetic retinopathy. However, it was found that clinical CME was seen more often than angiographic CME, in cases when diabetic retinopathy

was present preoperatively ( $p < 0.01$ ). Eventually the visual prognosis of angiographic CME was more favorable compared to clinical CME.<sup>7</sup>

Limitation of our study is that the subjects who underwent phacoemulsification were not included, and longer duration follow up was not possible. We could not find the angiographic CME as FFA was not done. Correlation between FFA and OCT finding would have given better results.



**Fig. 1:** OCT picture of a diabetic patient with macular oedema

## 5. Conclusion

Cystoid macular edema is a complex mechanism and is a result of multiple factors. Although lot of studies have been done in this field, the exact mechanism of CME in uncomplicated diabetics is unclear. Choosing the right surgery with proper IOL implantation is of utmost importance. Regular post operative follow up longer than usual for diabetic subjects and post operative OCT may help in detection and management of post operative cystoid macular edema.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

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