COMPARITIVE EVALUATION OF CLINICALLY SIGNIFICANT MACULAR EDEMA WITH OCT & SLIT LAMP BIOMICROSCOPY.

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ABSTRACT

COMPARITIVE EVALUATION OF CLINICALLY SIGNIFICANT
MACULAR EDEMA WITH OCT & SLIT LAMP
BIOMICROSCOPY.

Aim: To study and compare OCT and biomicroscopy in evaluation of CSME

Methods: After angiographic evaluation to rule out macular ischemia, 100 eyes of CSME were analyzed

Results: Though spongy edema was a universal feature, OCT analysis revealed five subgroups of patients. Group 1: spongy macular thickening (100%); Group 2: Thickening with ERM (2%); Group 3: Thickening with VMT (10%); Group 4: Thickening with CME (38%); Group 5: Thickening with SRF (8%).

Conclusion: OCT helps in better anatomical characterization of CSME and therefore more relevant while planning management strategies.
SCOPE OF STUDY

Diabetic macular edema is the commonest cause of visual loss in patients with non proliferative diabetic retinopathy and a common cause of visual loss in PDR. According to ETDRS, early detection and laser treatment of CSME decreases the risk of moderate visual loss by 50%. Though laser has been the standard of care till recently, many new treatment modalities are now available in the management of CSME. Even in the ETDRS, many patients treated with laser did not improve and actually had a visual drop, especially those patients with diffuse CSME. Why laser should be effective in certain subgroup and why not in other subgroup could not be explained at that time.

Traditional methods of evaluating macular thickening including slit lamp biomicroscopy and fundus photography are relatively insensitive to small changes in retinal thickness and also unable to detect specific anatomic details especially at vitreomacular interface. Thus new techniques for quantitatively and qualitatively measuring retinal thickness have been explored. Recent imaging techniques can provide tomographic or cross sectional images of macula and can yield powerful diagnostic information, which is complimentary to FFA and fundus photo.

Optical Coherence Tomography (OCT) is a new medical diagnostic imaging technology which can perform micrometer resolution cross-sectional or tomographic imaging of macula. The operation of OCT is analogous to ultrasound B-mode imaging except that light is used
rather than acoustic waves. OCT is established in the diagnosis of various macular disorders including CSME, macular hole, CNVM etc.¹

The aim of the study was to study and classify the OCT characteristics of clinically significant macular edema, to correlate with vision and to compare biomicroscopy with OCT.
**MATERIALS & METHODS**

This was a prospective study done between April 2006 and June 2006 in patients who attended the retina clinic of Chaithanya eye Hospital, Trivandrum. 100 eyes (70 patients) of CSME were evaluated. The study group included both Insulin dependent and non insulin dependent PDR and NPDR patients between the age of 40 & 80 yrs. The study population had varied glycemic levels and HbA1c evaluation was not done. None of the patients in our study had undergone previous focal laser or pan-retinal photocoagulation. Such patients were excluded as these could interfere with anatomic changes at the macula and may not be singularly due to disease manifestation. Few of the patients had associated other systemic diseases like hypertension, nephropathy & hypercholestremia and were on medications. The duration of diabetes was 7yrs to 33yrs.

All patients underwent visual acuity estimation by Snellens Visual Acuity Chart, dilated Slit lamp- 90D examination, Fundus Fluorescein Angiography and Optical Coherence Tomography-4 by the same examiner. We considered macular edema to be clinically significant as defined by the Early Treatment Diabetic Retinopathy Study (ETDRS) protocol – that is, if there was retinal thickening or hard exudates associated with adjacent retinal thickening observed within 500 +/- 50 microns of the centre of foveal avascular zone or a zone or zones of retinal thickening 1 disc area or larger, any part of which was within 1 disc diameter of the center of the macula.
We classified patients into 4 groups based on slit lamp biomicroscopy findings as Gr.1a- non diffuse CSME, Gr.1b- diffuse CSME, Gr.2-CSME with ERM, Gr.3- CSME with VMT/thickened posterior hyaloid, Gr.4- CSME with CME. A diagnosis of diffuse CSME was made if CSME involved the perifoveal region all around or atleast three quadrants. FFA was done to classify the disease, to diagnose early PDR, CME and to rule out macular ischemia. Macular ischemia was defined on FFA as enlargement of foveal avascular zone compared to other eye with area of segmental/focal perifoveal capillary loss. Patients with macular ischemia were excluded from the study as these patients could alter the interpretation of results, which also aimed at correlating visual deficit with biomicroscopic and OCT features. OCT stratus-4 was done in all eyes, preferably a line scan programme was chosen and the image processed and analyzed. Based on OCT findings, we classified CSME into five groups, Gr.1- macular thickening with only spongy edema, Gr.2- macular thickening with ERM, Gr.3- macular thickening with VMT, Gr.4- macular thickening with CME and Gr.5- macular thickening with SRF.
OBSERVATION

Of the total 70 patients, there were 17 patients in 40-49yrs age group (24%), 29 in 50-59 yrs age group (42%), 21 in 60-69 age group (30%), 3 in 70-79 age group (4%) and none above 80 yrs. Males predominated in the study with 66%. The male: female ratio was 2:1. Of the 70 patients, 45 had NPDR (64%) and 25 had PDR (36%).

Biomicroscopically, 52% had diffuse CSME (Gr.Ia), 48% had focal CSME (Gr.Ib), 16% had CSME with CME (Gr.IV) and 2% had CSME associated with VMT (Gr.III) in the order of frequency. No patient had ERM and SRF clinically.

OCT examination revealed macular thickening with spongy edema in all patients (100%), macular thickening (ME) associated with CME in 38%, ME associated with VMT in 10%, ME associated with SRF in 8% and ME associated with ERM in 2%. On OCT, eyes with spongy edema showed diffuse thickening of macula with small cystic spaces. Eyes with CME showed large cystic spaces in the foveolar and parafoveal region. VMT was seen as hyper-reflective band in the vitreous, which was adherent to the fovea, either centrally or paracentrally, causing traction and pulling up the macula. None of the patients had a defect suggestive of hole formation. SRF was seen as a subfoveal detachment on line scans. ERM was identified as a hyper-reflective thickening at the level of internal limiting membrane, causing distortion and flattening of the foveal surface.

On comparing OCT with biomicroscopy/FFA, 38% of the eyes had CME on OCT, compared to 16% detected on biomicroscopy/FFA. 8% of
eyes had SRF with subfoveal detachment on OCT and was not identified on biomicroscopy. 10% of eyes had VMT on OCT, compared to 2% on biomicroscopy. 2% ERM was identified by OCT compared to none on biomicroscopy.

Correlation with vision

<table>
<thead>
<tr>
<th>Vision</th>
<th>Biomicroscopy</th>
<th>OCT</th>
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<tbody>
<tr>
<td>6/6</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>&lt;6/6</td>
<td>70%</td>
<td>70%</td>
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</tbody>
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Correlation of biomicroscopic and OCT finding with visual acuity revealed that 30% of eyes had a visual acuity of 6/9 or better, while 70% had vision worse than 6/9. Of those in biomicroscopy group with less vision, only 18% could be attributed to CME & VMT. No obvious clinical cause for defective vision was detected in the rest 52% eyes with visual loss. In OCT group, 58% could be attributed to CME, VMT, SRF & ERM. No obvious clinical cause for defective vision was detected in the rest 12% eyes with visual loss.
STATISTICAL ANALYSIS

A comparative analysis between biomicroscopy and OCT evaluation was done by Average method (Percentage calculation).

Shown below are the results obtained.

<table>
<thead>
<tr>
<th></th>
<th>BIOMICROSCOPY</th>
<th>OCT</th>
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</thead>
<tbody>
<tr>
<td>SE</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>CME</td>
<td>16</td>
<td>38</td>
</tr>
<tr>
<td>ERM</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>VMT</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>SRF</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

Total number of samples = 100
Expected result in numbers = 100 (Assuming that both BIOMICROSCOPY and OCT proves to be perfect.

**Spongy edema**

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<thead>
<tr>
<th></th>
<th>BIOMICROSCOPY</th>
<th>OCT</th>
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<tr>
<td></td>
<td>100</td>
<td>100</td>
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Result: By statistical analysis expected result and observer result proved to be the same.

Inference: Both Biomicroscopy and OCT methods can be adopted.

**Cystoid Macular Edema**

<table>
<thead>
<tr>
<th></th>
<th>BIOMICROSCOPY</th>
<th>OCT</th>
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<tbody>
<tr>
<td></td>
<td>16</td>
<td>38</td>
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</table>

Result: By Biomicroscopy, 16% of the total observations proved to be valid and by OCT, 38%.

Inference: OCT is found to be more perfect compared to biomicroscopy.
OCT method can be adopted for CME.
**Epiretinal Membrane.**

<table>
<thead>
<tr>
<th>BIOMICROSCOPY</th>
<th>OCT</th>
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<tbody>
<tr>
<td>0</td>
<td>2</td>
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</table>

Result: By Biomicroscopy, 0% of the total observations proved to be valid and by OCT, 2%.

Inference: OCT found comparatively better than biomicroscopy. OCT method can be adopted for ERM.

**VitreoMacular traction.**

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<tr>
<th>BIOMICROSCOPY</th>
<th>OCT</th>
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<tr>
<td>2</td>
<td>10</td>
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Result: By Biomicroscopy, 2% of the total observations proved to be valid and by OCT, 10%.

Inference: OCT found comparatively better than biomicroscopy. OCT method can be adopted for VMT.

**Subretinal Fluid**

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<tr>
<th>BIOMICROSCOPY</th>
<th>OCT</th>
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<tbody>
<tr>
<td>0</td>
<td>8</td>
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Result: By Biomicroscopy, 0% of the total observations proved to be valid and by OCT, 8%.

Inference: OCT is found to be more perfect compared to biomicroscopy. OCT method can be adopted for SRF.

**Conclusion:**

From the given set of samples detecting 5 items on these two tests, except for SE, OCT is found to be statistically superior to BIOMICROSCOPY based on average method. (Percentage calculation)
ANALYSIS

Although slit lamp biomicroscopy is highly sensitive for qualitative detection of CSME and FFA for detection of fluid leakage, various studies have ascertained that qualitative assessment and quantitative measurement of retinal thickening may correlate better with retinal dysfunction in patients with CSME. OCT enables the clinician to study their effects and show accurate subclinical retinal changes that may not be even detectable in FFA.

Yang et al\textsuperscript{12} have suggested that the criteria of CSME seems to be insufficient in identifying macular edema and that OCT may be more sensitive than a clinical examination in assessing diabetic macular edema and is a better tool for documenting changes in macular thickening. OCT-identified spongy retinal thickness and / or CME was seen in 58\% of eyes without CSME in that series. In our series, we found spongy thickening in all the eyes and CME in 38 \% with macular edema. Schaudig\textsuperscript{11} et al also found similar observations who in addition also showed a significant increase in macular thickening in diabetic patients without retinopathy compared to non-diabetic subjects. Browning\textsuperscript{3} et al had demonstrated that the agreement between clinical examination and OCT was good for moderate and severe macular thickening (>300 microns) and poor for mild macular thickening (200-300 microns). Most of these studies have also found a positive correlation between increasing macular thickening and visual loss.

With the advent of newer medical therapies, intravitreal triamcinalone, PST triamcinalone, intravitreal anti-VEGF therapy and
vitrectomy for CSME, the role of laser in the management of CSME is better reserved for selected groups of patients. OCT provides for a better anatomical description of CSME for identification of the medically and surgically treatable groups.

Hence our characterization of CSME patients based on OCT into macular thickening with only spongy edema (Gr.-1), macular thickening with ERM (Gr.-2), macular thickening with VMT (Gr.-3), macular thickening with CME (Gr.-4) and macular thickening with SRF (Gr.-5) is more relevant. Structural changes in OCT in our series correlate with other data from literature. Otani et al found spongy retinal swelling in 88%, CME in 47% and SRF in 15% of eyes with CSME. Kim et al found spongy retinal swelling in 97%, CME in 55%, SRF in 7%, VMT in 13% of eyes with CSME. Ozdek et al had reported spongy retinal swelling in 66%, CME in 16% and SRF in 10% of eyes with diabetic macular edema. In our study, we found spongy retinal swelling in 100%, CME in 38%, SRF in 8% and VMT in 10%.

On comparing OCT with biomicroscopy, 38% of the eyes had CME on OCT, compared to 16% detected on biomicroscopy. 8% of eyes had SRF with subfoveal detachment on OCT and was not identified on biomicroscopy. 10% of eyes had VMT on OCT compared to 2% on biomicroscopy. 2% of eyes had ERM identified by OCT compared to none on biomicroscopy. Browning et al had also compared stereoscopic slit lamp examination and OCT in the study of CSME and concluded that stereoscopic slit lamp examination of the macula was less sensitive than OCT for detection of diabetic macular edema. Strom et al had
found an agreement of 89% on the exact location and 84% agreement on the exact area of CSME when he compared biomicroscopy with OCT and found the latter to be more superior.

In our study, 38% of the eyes had CME on OCT, compared to 16% detected on biomicroscopy. Ozdek\textsuperscript{8} et al also found that 40% of CME detected on OCT were not detected by biomicroscopy and 63% were not detected even on fluorescein angiography. OCT is thus a better diagnostic tool to diagnose CME in patients with diabetic retinopathy than biomicroscopy or FFA. Kim et al also had reported that the presence of CME in patients with CSME was significantly associated with worse vision. In our study, 8% of the eyes had SRF with subfoveal detachment, which could not be detected on biomicroscopy or FFA. Most series have found SRF in 8-12% of eyes with CSME. Ozdemir\textsuperscript{14} et al had reported that 31% of diabetic CMEs had subretinal fluid. Previously it was believed that SRF was seen in eyes with taut thickened posterior hyaloid, but many series had found evidence to the contrary. Thomas et al\textsuperscript{7} found SRF to be associated with taut hyaloid in only 33% of eyes and the rest without posterior hyaloid separation.

10% of eyes in our series had VMT on OCT compared to 2% on biomicroscopy. VMT has been reported by various authors between 10-60% of eyes with CSME. One study which specifically looked at vitreoretinal interface changes in CSME found no PVD in 40% eyes, 53% perifoveal PVD, 2% with incomplete PVD attached to disc and 6% with complete PVD. These results show that though PVD is not the main factor involved in the pathogenesis of diabetic macular edema,
perifoveal PVD may have a role in the development of this complication. This may have a bearing on planning management strategies especially with regards to indications for vitrectomy for CSME.

ERM was also detected in 2% of eyes on OCT compared to none on biomicroscopy in our study. Subtle ERM may therefore be missed on routine clinical examination and may need OCT to diagnose it. Wilkins et al\textsuperscript{2} found two types of ERM in patients with CSME, globally adherent ERM in 67% and focally adherent ERM n 33%. This may be another indication for vitrectomy in CSME.

As macular ischemia can be a cause of visual defects in patients with CSME, the present study excluded this subgroup of patients during the analysis. Correlation of biomicroscopic finding with visual acuity revealed that 30% of eyes had a visual acuity of 6/9 or better, while 70% had vision worse than 6/9. Of those with less vision, only 18% could be attributed to CME & VMT. No obvious clinical cause for defective vision was detected in the rest 52% eyes with visual loss.

OCT evaluation of those eyes with visual acuity of less than 6/9 revealed CME in 38% of these eyes, VMT in 10% eyes, SRF in 8% eyes and ERM in 2% of eyes, thereby offering a better understanding of the cause of visual loss in these patients. Alkuraya et al had reported that there was a positive correlation between the type of OCT finding and visual acuity. Patients with CME and VMT had worse vision. Most of the other series had reported that the visual acuity correlated better with macular thickness, ie. more the central foveal thickness, worse the vision. It is also known that the central foveal thickness increases with
the different types of OCT presentations, being least for spongy thickening, moderate for CME/SRF and highest for VMT and thus visual loss mirrors these changes.

Thus these structural changes correlate better with the visual defects the patients with CSME have in the absence of macular ischemia in our series. Detection of these findings has a bearing in planning treatment strategies. Eyes with CME and SRF will probably respond poorly to conventional laser and require additional medical management in the form of IVTA or PST. Eyes with VMT and ERM probably are poor candidates for laser and are better managed by primary vitrectomy. Identification of these findings on OCT will optimize treatment in CSME, which will have a bearing on the final visual acuity maintained or achieved.
CONCLUSION

We found that OCT is a useful technique for quantitative measurement and helps in better anatomical characterization of CSME than biomicroscopy and thereby more relevant while planning management strategies, followup, prognosis and predicting visual income.

We found that OCT is better compared with biomicroscopy to diagnose CME, to detect subretinal fluid with subfoveal detachment and to study the vitreoretinal interface changes like vitreomacular traction & epiretinal membrane.

OCT characterization of CSMEs identified groups that correlate better with visual acuity than slit lamp biomicrocopy.

Patients with CSME and only spongy macular thickening on OCT probably respond better to conventional laser therapy. Patients with CME/SRF respond best to IVTA/PST with or without focal laser and patients with ERM/VMT respond best with vitrectomy.
ILLUSTRATIONS

Spongy edema on OCT only

CME on OCT only
VMT on OCT only

SRF on OCT only

VMT on OCT only
Comparison – OCT Vs Biomicroscopy

![Comparison Chart]

ERM on OCT only
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11. Optical coherence tomography for retinal thickness measurement in diabetic patients without clinically significant macular edema; Schaudig et al; Ophthal Surg Laser 2000; 31(3): 182-6


DECLARATION

I, Dr. ANU ANNA PAUL hereby declare that this dissertation entitled “COMPARITIVE EVALUATION OF CLINICALLY SIGNIFICANT MACULAR EDEMA WITH OCT & SLIT LAMP BIOMICROSCOPY.” is an original work done by me at Chaithanya Eye Hospital & Research Institute, Trivandrum

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