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A Clinical Study on Correlation of Optical Coherent Tomography and Fundus Fluorescein Angiography Finding in Diabetic Macular Edema

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Abstract: ***Diabetic macular edema is a major cause of visual morbidity in patients with Diabetes. It usually results from breakdown of inner blood-retinal barrier. Early detection of Retinal abnormalities is important in preventing Diabetic macular edema and subsequent visual loss. Aim: To know the correlation of Optical coherent tomography and Fundus fluorescein angiography finding in diabetic macular edema. Materials and Methods: This was a cross sectional study done in Regional institute of ophthalmology, Gauhati Medical College. All patients who were diagnosed as CSME underwent complete ophthalmological examination and subjected to OCT and FFA Results: A total of 50 patients were studied. Among 92 eyes with CSME, OCT shows 54 eyes [58.69%] having sponge like retinal thickening, 29 eyes [31.52%] having cystoids pattern, Serous RD, in 6 eyes [6.52%] and vitreomacular traction in 3 eyes [3.26%]. FFA in eyes with CSME showed, focal leakage in 38 eyes [41.30%], Diffuse leakage in 24 eyes[26.08%] ,27 eyes[29.34%] showed both focal and diffuse leakage, whereas 3 eyes[3.26%] showed ischemic maculopathy pattern. Conclusion: There is a significant (p<0.0001) correlation between mean OCT (foveal thickness) with the types of maculopathy detected by FFA.***

Keywords: Diabetic Macular Edema,Optical Coherent Tomography,Fundus Fluorescein Angiography

1. Introduction

Diabetic Retinopathy[DR] and Diabetic macular edema[DME] are common microvascular complications in patients with Diabetes and may have a sudden and debilitating impact on visual acuity[VA],eventually leading to blindness. Diabetic macular edema which is manifested as retinal thickening primarily due to exudation from incompetent macular capillaries, is the most common cause of moderate visual loss[MVL][defined as a doubling of the visual angle, for example,20/40 to 20/80 or a loss of 15 or more letters on the ETDRS chart] in patients with Diabetes mellitus[3].According to the ETDRS ,the 3 year risk of MVL in untreated patients with CSME is 33%[1] .

Macular edema is an important manifestation of Diabetic Retinopathy.The edema at the macula is intercellular fluid which comes from leaking micro aneurysms or from diffuse capillary leakage.

Characteristics of Clinically Significant Macular Edema (CSME)2

It is diagnosed by stereoscopic assessment of retinal thickening, usually by slit lamp biomicroscopy with a 78D or 90 D lens. It is defined as the presence of one or more of the following (Modified Airlie –House Criteria) -

1) Retinal edema within 500 microns of the centre fovea.
2) Hard exudates within 500 microns of fovea if associated with adjacent retinal thickening
3) Retinal edema that is one disc diameter (1500 microns) or larger , any part of which is within one disc diameter of the centre of the fovea

Diabetic maculopathy can be diagnosed using noncontact/contact stereoscopic biomicroscopy, fluorescein angiography (FA), and optical coherence tomography (OCT)[3] .

Diagnosis of diabetic macular edema is best made by slit lamp biomicroscopy of the posterior pole using a contact lens. It is however insensitive to small changes in retinal thickness, for example, a subtle CSME is difficult to appreciate, or small intra retinal cystoid spaces or subtle epiretinal changes[4] .

Fundus Fluorescein Angiography (FFA) can assess macular edema qualitatively and OCT provides quantitative measurement of foveal thickness. Therefore, the patho-physiologial aspect of can be determined by FFA and anatomical features such as the extent of retinal thickening and the retinal layer involved can be assessed best using OCT[3] .

A comparative study is needed to study the efficacy of these two tests to diagnose macular edema early in the course of the disease and to detect which test can detect the early changes in diabetic maculopathy. This study may help in detecting whether non-invasive tests are comparable to invasive tests like FFA.

2. Materials and Methods

This cross sectional study was conducted in the Regional Institute of Ophthalmology ,Gauhati Medical College and Hospital during the period of September 2014 to August

2015.The study was conducted after seeking Ethical clearance from the Institutional Ethics Committ The patients were selected from the outdoor as well as indoor of Regional Institute of Ophthalmology, Gauhati Medical College and Hospital .Patients with Diabetic Retinopathy attending for ophthalmological evaluation detected as Diabetic Maculopathy [Diagnosed according to ETDRS criteria] were included .Both male and female patients above 21 years were taken as cases. Total 50 patients were taken for the study. Exclusion criteria: Patients with active PDR with Vitreous haemorrhage, dense media which interfare good OCT/FFA image, Macular edema due to other cause like Central retinal vein occlusion, recent ocular surgery(<3months) and all other macular pathology like Age related macular degeneration.

After taking written informed consent, a detailed history was taken. General and systemic examination was done and signs of any complications of Diabetes noted. They underwent an ophthalmic examination in the form of visual acuity, both near and distance including pin hole and best corrected visual acuity, Slit Lamp Examination and dilated fundus examination. Fundus was examined by slit lamp biomicroscopy using +90 diopter(D) volk lens and indirect ophthalmoscopy using +20D volk lens.FFA was performed under the supervision of an anaesthetist and fundus photograph was taken following injection of fluoresce in dye. **OCT imaging** was performed using the stratus OCT machine model 3000[carl Zeiss Meditec Inc] with software version 4.0, which provides an axial resolution of less than 10 um. The fast macular thickness protocol was used. Statistical analysis: Descriptive statistics were applied where ever necessary. For comparisons of means between the groups ANOVA was applied and to find the correlation between the variables Pearson's correlation of coefficient was applied considering $p<0.05$ to be significant.

3. Results

A total of 92 eyes of 50 diabetic patients with DME were included in the study of which 38(76%) were male and 12(24%) were females.

(a)Age distribution
All patients were between 40 to 79 years with 25 patients (50%) in 50 to 59 years,12 patients(12%) in 40 to 49 years ,11 patients(22%) in 60 to 69 years and 2 patients(4%) in 70 to 79 years range. No patients found between 21 years to 39 years of age with Diabetic Macular edema in the present study.

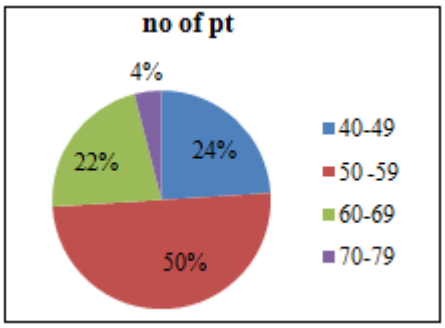

Figure: Pie diagram showing age distribution

(b)Duration of Diabetes mellitus:

Duration of diabetes mellitus [in years]	No of patients	Percentage
0-4 years	3	6%
5-9 years	16	32%
10-14 years	23	46%
15 years and more	8	16%
Total	50	100%

(c)Analysis of Macular edema:
Out of 50 patients having CSME 42[84%] had bilateral CSME whereas 8[16%] patients had unilateral CSME.Thus ,we had a total of 92 eyes with CSME.

(d) Foveal thickness on OCT
Based on the foveal thickness on OCT,we divided the 92 eyes having CSME into 3 groups:
A.Foveal zone thickness less than 350 µ
B.Foveal zone thickness between 350-450 µ
C.Foveal zone thickness more than 450µ

Table: Grouping of patients based on Foveal thichness

Foveal zone thickness	No. of eyes (N=92)	Percentage
A.Less than 350µ	47	51.08%
B.350-450µ	35	38.04%
C.More than 450µ	10	10.86%

(e)OCT pattern of Diabetic Macular Edema(DME)
OCT showed retinal thickening in all 92 eyes with CSME diagnosed on slit lamp bimicroscopy.54 eyes [58.69%] showed sponge like retinal thickening ,29 eyes [31.52%] showed cystoids pattern which appeared as round or oval areas of low reflectivity with highly reflective septa separating the cystoids cavities. Serous RD ,characterised by accumulation of subretinal fluid beneath a highly reflective dome like elevation of the detached retina associated with edema was present in 6 eyes[6.52%] and vitreomacular traction was seen in 3 eyes [3.26%].

Table: OCT pattern of DME

Patterns	No of eyes (n=92)	Percentage[%]
Spongy pattern	54	58.69%
Cystoid	29	31.52%
Serous retinal detachment	6	6.52%
Vitreomacular traction	3	3.26%

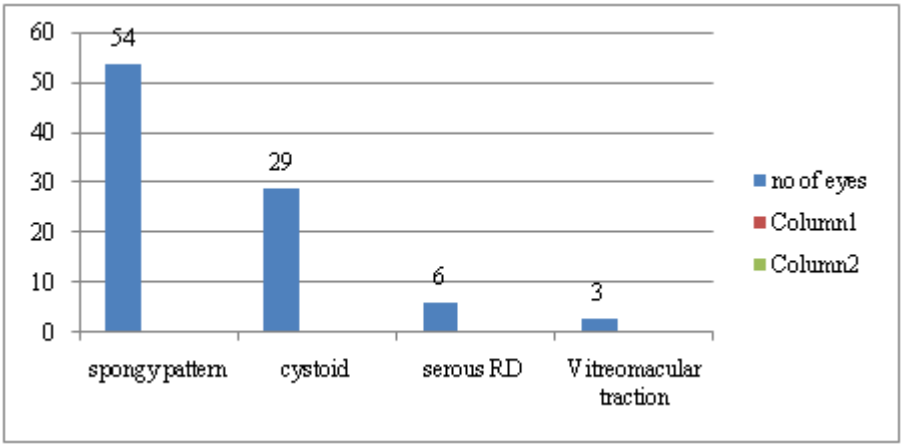

Figure: Bar diagram showing OCT pallern of DME

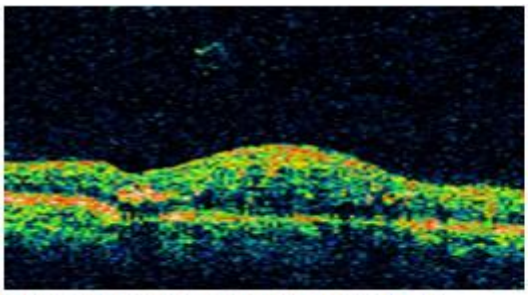

Figure: Spongy pattern of DME on OCT

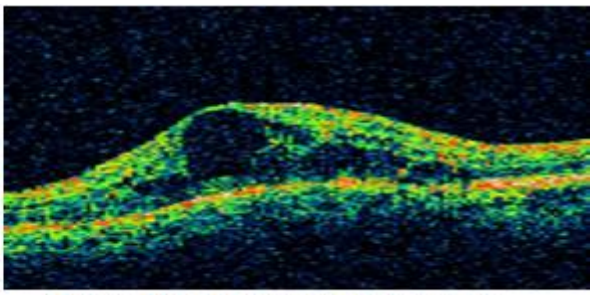

Figure: Cystoid Pattern of DME on OCT

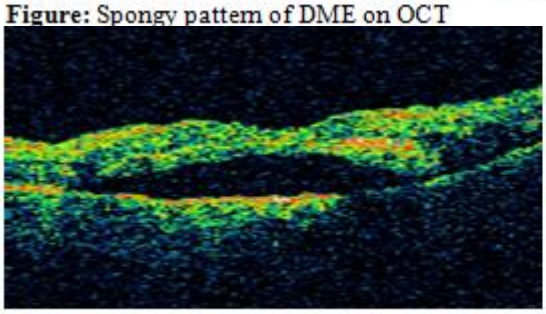

Figure: Serous retinal detachment on OCT

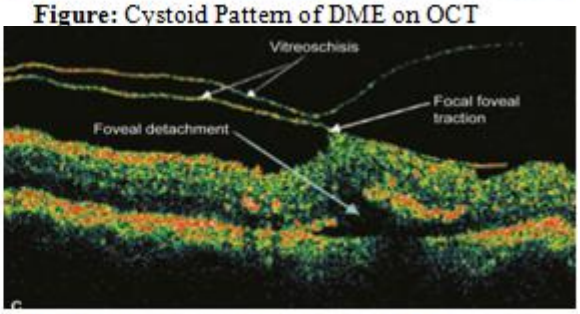

Figure: Vitreomacular traction on OCT

(f)Pattern of leakage on FFA

FFA in eyes with CSME showed, focal leakage from microaneurysms in 38 eyes [41.30%] .Diffuse leakage was seen in 24 eyes[26.08%] ,27 eyes[29.34%] showed both focal and diffuse leakage, whereas 3 eyes[3.26%] showed ischemic maculopathy pattern.

Table: Pattern of FFA leakage

Types of leakage on fluorescein angiography	No of eyes (n=92)	Percentage[%]
Focal	38	41.30%
Diffuse	24	26.08%
Focal +Diffuse	27	29.34%
Ischemic maculopathy	3	3.26%

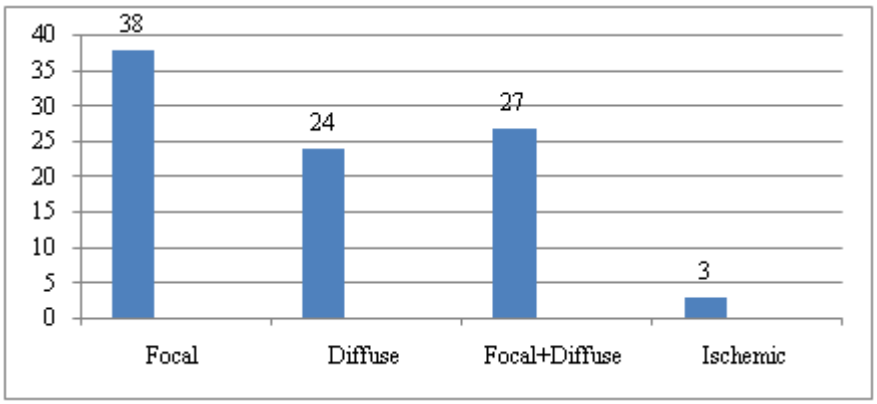

Figure: Bar diagram showing different pattern of leakage in FFA

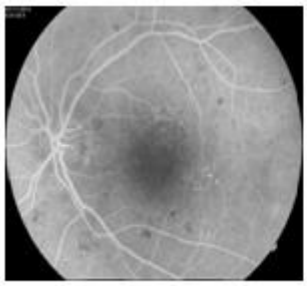

Figure: Focal leakage on FFA

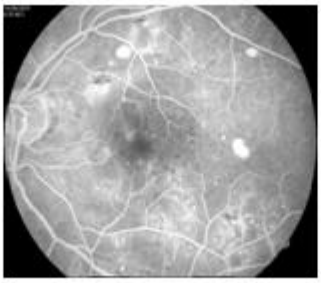

Figure: Diffuge leakage on FFA

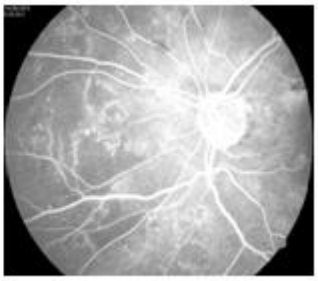

Figure: Focal+Diffuge leakage on FFA

(g)Correlation of OCT and FFA finding in DME

In our study 50 patients of Diabetic macular edema[DME],OCT and FFA done on the same day.FFA leakage are---no leakage, focal leakage, diffuge leakage, diffuse+focal leakage and ischemic pattern of maculopathy.Among the 100 eyes 92 eyes had DME.8 eyes without DME shows no leakage on FFA.Among 92 eyes ,38 eyes have focal leakage, 24 eyes have diffuse leakage,27 eyes have diffuse and focal leakage and 3 eyes have ischemic maculopathic changes on FFA.

Figure 18: Types of Maculopathy acc to FFA and Foveal thickness on OCT

Foveal thickness (OCT)	No leakage	Focal	Diffuse	Diffuse+ Focal	Ischemic
Mean	177.50	280.37	374.63	445.00	272.00
St.deviation	8.864	49.124	84.381	106.13	31.177

On applying ANOVA following results obtained—
F=29.73 , DF=4,95
P <0.0001, significant.

From the above data it is seen that there is difference between the mean OCT(foveal thickness) values of the types of maculopathy detected by FFA and these differences are statistically significant (P <0.0001). Thus we conclude that there is association between OCT (foveal thickness and FFA finding in clinically significant diabetic macular edema. The combined data from both OCT and fluorescein angiography may provide a clearer understanding of the anatomic and physiologic characteristics of clinically significant diabetic macular edema.

4. Discussion

(a)Age distribution

In the present study, we have taken 50 patient with Diabetic macular edema with age more than 21years. All patients were between 40 to 79 years with 25 patients (50%) in 50 to 59 years, 12 patients (24%) in 40 to 49 years, 11 patients (22%) in 60 to 69 years and 2 patients (4%) in 70 to 79 years range. No patients found between 21 years to 39 years of age in our study. The largest no of patients with DME were in the age group 50-59 years which account for, 25[50%], followed by 12[24%] in the age group 40-49 years, 11 [22%] in the age group of 60-69 years and the lowest, 2[4%] in the age group of 70-79 years. The overall mean age was 54.84±7.29 year. In the study by **Lawson et al** [5],the mean patient age was 58 years[range 29-73 years], In the study by **Sander et al** [6],the mean age of the patient was 57 years[range 28-71 years], In the study **Kang et al[2004]**[7],the mean age of patients was 59.9 years[range 31-86 years]. Thus, the mean age of the patients in our study was comparable to most of other studies.

(b)Sex distribution:

In our study, out of the 50 patients 38[76%] were male and 12[24%] were females. The mean age in males [mean±SD]was 54.35 ± 7.62years and the mean age in female[mean±SD] 55.41 ±6.41years .Therefore, more number of male patients were found in our study. In the study**, Golubovic Arsovska**[8] a mild dominance of female [55.8%] versus males[44.2%] was observed. **The Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR), Klien *et al***[9] found that increased incidence of DME additionally associated with female sex, apart from other factors. **Vitale S et al** [10], found an association with male sex.

(c)Duration of Diabetes mellitus

In the present study, the duration of diabetes mellitus of the patients ranges from 3 years to 18 years.Among the 50 patients,16 patients(32%) had diabetes mellitus since 5-9 years,23 patients(46%) since 10 -14 years,3 patients(6%) for 0-4 years and 8 patients(16%) for 15 years and more. Mean duration was 10.2±3.78 years.

The study by **Zhang et al**[11], showed that diabetic maculopathy often occurred within 10 years of diabetes duration and its severity and incidence increased years by year. In the study by **Kang et al** [7],average duration of Diabetes in patients having CSME found to be 15.09±7.49 years .**TH Chou et al[2009]**[12],found the mean duration of DM with CSME 11.2±5.5YEARS. In our study, duration of DM with CSME patients with the mean age10.2±3.78 years which is similar to the finding of other authors.

(d)OCT features

In our study, OCT showed retinal thickening in all 92 eyes with CSME diagnosed on slit lamp bimicroscopy.54 eyes [58.69%] showed sponge like retinal thickening ,29 eyes [31.52%] showed cystoids pattern. A serous RD present in 6 eyes[6.52%] and vitreomacular traction was seen in 3 eyes [3.26%]. In a study by, **Kang et al[2004]**[7] sponge like thickening was seen 55.2% eyes,cystoids pattern in 30.3%,serous RD in 11.7% and vitreomacular traction in 2.8% eyes. **Ozdek SC et al[2005]**[13],found sponge like retinal thickening in 66.1% eyes, cystoids macular edema in 11.8% eyes, SRD with sponge like pattern in 6.2% eyes and foveal traction was seen in 3.1% eyes. our study results were more or less similar to above studies.

(e)Types of maculopathy on FFA

In our study, FFA in eyes with CSME showed, focal leakage from microaneurysms in 38 eyes [41.30%] .Diffuse leakage

was seen in 24 eyes[26.08%], 27 eyes[29.34%] showed both focal and diffuse leakage, whereas 3 eyes[3.26%] showed ischemic maculopathy. In the study by **Jian Wanchen et al**[14],out of 211 eyes studied,126 eyes had focal edema [59.7%], 60 eyes had diffuse edema[28.4%] and 5 eyes had ischemic maculopathy [2,4%]. In the study by**, Zi-qin MA et al**[15],out of 819 eyes studied, 311 eyes showed focal macular edema[38%], 434 eyes showed diffuse macular edema including cystoids macular edema [53%] and 25 eyes showed ischemic maculopathy[3.1%]. So in our present study shows similar types of distribution of maculopathy on FFA.

(f)Correlation of Optical coherent tomography and Fundus fluorescein angiography finding in Diabetic Macular Edema

Kang SW et al[2004][7], assess the correlation between the features of optical coherence tomography (OCT) and fluorescein angiography in clinically significant diabetic macular edema. The prevalence of OCT type 1{thickening of the fovea with homogenous optical reflectivity throughout the whole layer of the retina} was higher in the focal leakage type (73.0%) and in the diffuse leakage type (58.9%) than in the diffuse cystoid leakage type (3.8%) of fluorescein angiography (P <.0001).

In our study, 50 patients of Diabetic macular edema[DME],OCT and FFA done on the same day.OCT showed foveal thickening in all 92 eyes with CSME diagnosed on slit lamp bimicroscopy.54 eyes [58.69%] showed sponge like retinal thickening ,29 eyes [31.52%] showed cystoids pattern. Serous RD present in 6 eyes [6.52%] and vitreomacular traction was seen in 3 eyes [3.26%].

Among the 100 eyes 92 eyes had DME. 8 eyes without macular edema shows no leakage on FFA. Among 92 eyes with DME,38 eyes(41.30%) have focal leakage,24 eyes(26.08) have diffuse leakage,27 eyes(29.34%) have diffuse and focal leakage and 3 eyes(3.26%) have ischemic maculopathic pattern on FFA.

On applying ANOVA following results obtained—
F=29.73 , DF=4,95
P <0.0001, significant.

From the above data it is seen that there is difference between the mean OCT values(foveal thickness) of the types of maculopathy detected by FFA and these differences are statistically significant (P <0.0001). Thus we conclude that there is association between OCT and FFA finding in clinically significant diabetic macular edema. The combined data from both OCT and fluorescein angiography may provide a clearer understanding of the anatomic and physiologic characteristics of clinically significant diabetic macular edema.

5. Conclusion

From our study it can be concluded that, there is a association between Optical coherent tomography [OCT] and Fundus fluorescein angiography[FFA] finding in Diabetic macular edema[DME] and found to be statistically significant. To summarize, OCT and FFA assist in early detection of Diabetic macular edema and selection of patients who can be benefit from treatment, identify what treatment is indicated, guide its implementing, and allow precise monitoring of treatment response.

6. Financial Support and Sponsorship

Nil

7. Conflicts of Interest

There are no conflicts of interest.

References

[1] Early Treatment Diabetic Retinopathy Study Research Group. Photocoagulation for diabetic edema.Early Treatment Diabetic Retinopathy Study Report No.1.Arch Ophthalmol 1985:103:1796-1806.
[2] Saxena S,Jalali S,Meredith TA,Holekamp NM,Kumar D.Management of diabetic retinopathy.Indian,J.Ophthalmol.2000;48;321-330
[3] Hee MR, Puliafito CA, Wong C, et al. Quantitative assessment of macular edema with optical coherence tomography. Arch Ophthalmol 1995;113:1019–1029.
[4] Goyal A et al.Diagnostic role of OCT in diabetic maculopathy. AIOC 2009 proceedings.
[5] Lawson PM, Hunt B, Kohner EM. Medical Conditions in patients with diabetic maculopathy. Diabet Med 1985;2(4):245-50.
[6] Sander B, Larsen M, Engler C, et al. Diabetic macular oedema: a comparison of vitreous fluorometry, angiography and retinopathy. Br J Ophthalmol 2002; 86:316-20.
[7] Sewoong Kang, Choul Yong Park, Don Ham. The correrlation between fluorescein angiographic and optical computed tomographic features in clinically significant diabetic macular edema. Am J Ophthalmol 2004;137:313-322.
[8] Golubovic-Arsovska M. Correlation of diabetic maculopathy and level of diabetic retinopathy. Section of Biological and Medical Sciences 2006;27(2):139-50.
[9] Ronald Klien,MD,Barbara E.K.Klien,MD,Scot E.Moss MA ,Karen j.Cruickshanks ,PhD.WESDR XV,The Long –term Incidence of Macular Edema.Ophthalmol 1995 :102:7-16.
[10] Vitale S, Maguire MG, Murphy RP, liner CJ, Rourke L, Sackett C, Patz A. Clinically significant macular edema in type I diabetes. Incidence and risk factors. Ophthalmology. 1995 Aug;102(8):l 170-6.
[11] Huirong Z, Xinrong L. Classification and visual prognosis of diabetic maculopathy. Chinese Journal of Ocular Fundus Diseases 2000-03.
[12] T-H Chou, P-C Wu, JZ-C Kuo, C-H Lai and C-N Kuo. Relationship of diabetic macular oedema with glycosylated haemoglobin. Eye (2009) 23, 1360—1363
[13] Sengul C Ozdek, M Alper Erdinc et al. Optical coherence tomographic assessment of diabetic macular edema: comparison with fluorescein angiographic and clinical findings. Ophthalmologica 2005;219:86-92.

[14] Wanchen J, Jian H, Jing L, et al. Fundus fluorescence angiography and classification study on diabetic maculopathy. Journal of Clinical ophthalmology 2001-04.
[15] Zi-qin M, Lei D, Jian-Lui G, et al. An investigation of the standard of classification of diabetic retinopathy according to fundus fluorescein angiography. Chinese Journal of Ocular Fundus Diseases 2003-06.

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