

# CHANGES IN CENTRAL MACULAR THICKNESS AND VISUAL ACUITY FOLLOWING SINGLE SESSION PANRETINAL LASER PHOTOCOAGULATION FOR DIABETIC RETINOPATHY

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## ABSTRACT

**Introduction:** Panretinal laser photocoagulation (PRP) have been the standard of care for patients with severe non proliferative diabetic retinopathy (NPDR) and proliferative diabetic retinopathy (PDR) in reducing severe vision loss. However, visual disabilities have been reported after PRP, including central visual loss caused by the development of macular edema. Therefore, the adverse effects of PRP including changes of central macular thickness and visual acuity need to be addressed.

**Purpose:** To evaluate the effect of single session PRP on central macular thickness (CMT) and visual acuity (VA) in patients with severe NPDR and PDR.

**Methods:** A descriptive study was conducted in newly diagnosed patients with severe NPDR and PDR with quantitative measurement of CMT and VA before single session PRP with follow up visit at 1 week and 2 weeks after treatment.

**Results:** Sixteen eyes of 14 patients were evaluated. The mean age were 49 (10,19). Baseline mean CMT was 284,47 (85,22), increased to 284,50 (62,74) at 1 week follow up and 296,93 (63,76) at 2 weeks follow up. Baseline mean VA was 0,33 logMAR (0,19), decreased to 0,35 logMAR (0,18) at 1 week follow up and 0,51 logMAR (0,40) at 2 weeks follow up.

**Conclusion:** Central macular thickness has a tendency to increase after single session PRP in short term follow up. Visual acuity may be worsened after single session PRP, but not more than two lines in short term follow up.

**Keywords:** panretinal photocoagulation, laser treatment, central macular thickness, diabetic retinopathy, visual acuity

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## INTRODUCTION

Diabetic retinopathy (DR) is the leading cause of blindness in the working population of industrially developed countries. With the rising incidence of diabetes mellitus, this ocular disease will, in the near future, be an even greater threat to worldwide health than it is today.<sup>1,2</sup>

Panretinal laser photocoagulation

(PRP) has been the standard of care for patients with severe non proliferative diabetic retinopathy (NPDR) and proliferative diabetic retinopathy (PDR) ever since the Early Treatment Diabetic Retinopathy Study (ETDRS) and the Diabetic Retinopathy Study (DRS). For years now, PRP have been the mainstay of severe NPDR and PDR treatment for inducing regression of

neovascularization and reducing the risk of severe vision loss. While the overall benefit of PRP is not disputed, visual disabilities have been reported after PRP, including central visual loss caused by the development of macular edema and peripheral visual loss from extensive, expanding inner retinal scarring.<sup>3-5</sup>

It has been reported that single session PRP using a pattern scan laser or even a conventional laser was not more hazardous than multi session PRP using a conventional setting in the treatment of PDR. Consequently, single session PRP is increasingly being performed to reduce both direct and indirect hospital visit expenses for patients. However, the adverse effects of PRP, including post laser macular edema need to be addressed. Optical coherence tomography (OCT) is able to quantitatively evaluate subtle changes in macular thickness and has been used for objective assessment for macular thickness changes in both clinical practice and in numerous clinical trials.<sup>6-10</sup>

The primary aim of this study is to evaluate the effect of single session PRP on central macular thickness, measured by spectral domain OCT, and visual acuity (VA) in patients with DR.

## **MATERIALS AND METHODS**

This was a descriptive study of newly diagnosed, treatment naïve

severe NPDR and PDR patients conducted at Vitreoretina unit, Cicendo Eye Hospital National Eye Center between July 10<sup>th</sup> and August 10<sup>th</sup> 2018. Patients with type 1 and type 2 diabetes and newly diagnosed DR were enrolled if they met the inclusion criteria.

Inclusion criteria included the following: (1) patients above 18 years old with newly diagnosed severe NPDR or PDR; (2) single session PRP performed with clear media; (3) spectral domain OCT with a signal-to-noise ratio of 0.6 or greater. Exclusion criteria included the following: (1) other retinal disease than DR; (2) history of prior PRP; (3) history of intraocular surgery within the last 6 months; (4) history of other treatment such as intravitreal injection or focal/grid laser; (5) coexisting ocular diseases that could influence visual acuity and macular thickness; (6) inadequate media clarity to perform complete laser in one session; (7) inadequate follow-up, defined as missing the 1- and/or 2-week follow-up visits.

Patients' baseline characteristics were recorded including age, sex, type and duration of diabetes, glycosylated hemoglobin A1C level, and disease laterality. All patients underwent a complete ophthalmic examination including UCVA (Snellen), intraocular pressure (IOP) using noncontact

tonometer, slit lamp biomicroscopy and dilated fundus examination. Central macular thickness measurement was performed with Carl Zeiss Meditec OCT fast macular cube 512x128. The patients underwent follow up at 1 week and 2 weeks after PRP. VA, IOP, slit lamp biomicroscopy, dilated fundus examination and OCT imaging were performed at each follow up visit.

PRP was performed with a slit-lamp using Mainster PRP 165 lens after informed consent was given. Laser procedures was done in 1 sitting using yellow or green laser system. Single clinician performed all PRP procedures according to the Early Treatment Diabetic Retinopathy Study (ETDRS) guidelines.

Descriptive analysis were performed for patients' baseline

characteristics, central macular thickness and VA before treatment and at each follow up visit. VA was converted to a logarithm of minimal angle of resolution (logMAR) units for statistical calculation. All data were reported as mean (standard deviation).

## RESULT

Total 16 eyes of 14 patients met all the eligibility criteria. Baseline characteristics are shown in Table 1. The mean age (SD) of the patients was 49 (10,19) years. Of the 12 patients (85,7%) had type 2 diabetes and 2 patients (14,3%) had type 1 diabetes. Ten patients (62,5%) was diagnosed with severe NPDR and 6 patients (37,5%) with PDR.

**Table 1. Characteristic of Patients**

<b>Characteristic</b>	<b>Mean ± SD</b>	<b>n (%)</b>
<b>Sex</b>		
Male		4 (28,6)
Female		10 (71,4)
<b>Age (year)</b>	49 ± 10,19	
<b>Duration of Diabetes</b>		
< 5 years		7 (50)
5-10 years		4 (28,6)
> 10 years		3 (21,4)
<b>Type of Diabetes</b>		
Type 1		2 (14,3)
Type 2		12 (85,7)
<b>Classification of DR</b>		
severe NPDR		10 (62,5)
PDR		6 (37,5)

For laser application, the mean total number (SD) of spots was 1508 (287) with mean laser power (SD) of 783 (302) mW delivered per eye. The laser parameters are shown in Table 2.

**Table 2. Laser Parameters**

Parameter	Mean ± SD	n
Total burn	1508 ± 287	
Power	783 ± 302	
Type of laser		
green		6
yellow		10

Mean CMT (SD) at baseline was 284,47 µm (85,22), with baseline CMT being less than 300 µm in 13 eyes. At 1 week follow up visit, the mean CMT (SD) was 284,50 µm (62,74) and at 2 weeks follow up visit the mean CMT

(SD) was 296,93 µm (63,76). Of the 13 eyes with baseline CMT being less than 300 µm, 1 eye had CMT measurement of 309 µm at 1 week follow up visit and 2 eyes had CMT measurement of more than 300 µm at 2 weeks follow up visit (300 µm and 311 µm). Changes of CMT during follow up are shown in Table 3.

Mean VA (SD) at baseline was 0,33 (0,19). At 1 week follow up, the mean VA (SD) was 0,35 (0,18) and at 2 weeks follow up the mean VA (SD) was 0,51 (0,40). Of the 13 eyes with baseline CMT being less than 300 µm, mean VA (SD) at baseline was 0,3 (0,17). At 1 week follow up, the mean VA (SD) was 0,33 (0,16) and at 2 weeks follow up the mean VA (SD) was 0,46 (0,34). Changes of VA during follow up are shown in Table 4.

**Table 3. Changes of Central Macular Thickness**

CMT	n	Pre PRP	1 week post PRP	2 weeks post PRP
		Mean ± SD	Mean ± SD	Mean ± SD
All eyes	16	284,47 ± 85,22	284,50 ± 62,74	296,93 ± 63,76
Baseline < 300 µm	13	250 ± 22,39	258,62 ± 24	268,64 ± 25,04

**Table 4. Changes of Visual Acuity**

Visual Acuity	n	Pre PRP	1 week post PRP	2 weeks post PRP
		Mean ± SD	Mean ± SD	Mean ± SD
All eyes	16	0,33 ± 0,19	0,35 ± 0,18	0,51 ± 0,40
Baseline CMT < 300 µm	13	0,3 ± 0,17	0,33 ± 0,16	0,46 ± 0,34

At 2 weeks follow up visit, 11 eyes (68,7%) have stable or improved VA than baseline and 5 eyes (31,3%) had worsened VA than baseline as shown in table 5.

**Table 5. Final Visual Acuity**

Visual Acuity	n(%)
Stable or improved	11 (68,7)
Worsened	5 (31,3)

## DISCUSSION

This present study evaluate changes of CMT and VA after single session PRP in patients with newly diagnosed severe NPDR and PDR. In this study we found that the mean CMT at 1 week follow up visit was increased by 0,03 µm and further increase were seen on 2 weeks follow up visit with final mean CMT (SD) of 296,93 µm (63,67). There were 13 eyes with baseline CMT being less than 300 µm with increased of mean CMT from baseline at follow up visits. Of those, 2 eyes had CMT measurement of more than 300 µm at 2 weeks follow up visit.

We also found changes in VA in

this study, with mean difference of 0,02 logMAR units at 1 week follow up visit and mean VA (SD) of 0,51 logMAR units (0,40) at 2 weeks follow up visit. However, most of the patients had stable or improved VA at the end of the study.

ETDRS reported an increased risk of worsening macular edema leading to loss of visual acuity in patients with pre existing macular edema at the onset of PRP treatment compared to those without macular edema.<sup>4</sup> Several studies have also described worsening macular edema immediately following PRP, but the visual acuity outcomes in those study are generally favorable.<sup>7-12</sup> A non randomized observational study conducted by DRCR.net revealed central subfield thickness was slightly greater at the 3-day and 4-week visits. Visual acuity differences paralleled OCT differences.<sup>13</sup>

In this study, macular thickening observed at 2 weeks after PRP. Similar result were reported by Watanachai et al., with increased of CMT by 24 µm

from baseline (274,3  $\mu\text{m}$ ) in patients with PDR who received single session multispot PRP. In that study, BCVA were significantly increase in mean logMAR unit from 0,13 to 0,18 at 4 week follow up compared to baseline BCVA.<sup>14</sup> Soman et al., also reported increase of CMT at 1 month after PRP in patients without clinically significant macular edema prior to PRP. Shimura et al., compared visual outcome and macular edema between weekly versus biweekly PRP. In that study, visual acuity was unaltered inspite of 142% increase of mean foveal thickness after PRP in both group. Type of macular edema seen on OCT appeared to be more relevant and better correlated with visual outcome than quantitative estimation of foveal thickness.<sup>15</sup> Present study shows a trend toward an increase in mean logMAR VA at 2 weeks follow up visit compared to baseline VA, however most of the patients had stable or improved VA at 2 weeks follow up visit. Shimura et al. reported that the change in foveal thickness did not correlate with the change in visual acuity, in which 84% of their patients maintained vision during follow up after PRP despite increase of foveal thickness.<sup>16,17</sup>

Limitation of this study were small sample size, short duration of follow up, and usage of different laser system. Systemic conditions related to diabetic retinopathy were not evaluate

in this study. Further study included factors associated with the development of macular edema after PRP can be conducted with larger sample size and long term follow up to evaluated further changes of CMT and VA after PRP.

## CONCLUSION

In conclusion, central macular thickness has a tendency to increase after single session PRP in short term follow up. Visual acuity may be worsened after single session PRP, but not more than two lines in short term follow up.

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