ORIGINAL ARTICLE

# Sub-threshold frequency doubled Nd. YAG modified mild maculr grid laser for diffuse diabetic maculopathy

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## Abstract

**Objective:** To determine the anatomical and functional improvement in eyes with diffuse macular oedema after modified mild macular grid laser.

**Methods:** The prospective study was conducted at the Department of Ophthalmology Unit II, Civil Hospital Karachi, and the Department of Ophthalmology, Dow International Medical College, Karachi, from June 2011 to May 2014. We used neodymium-doped yttrium aluminium garnet 532nm frequency-doubled green laser to treat all eligible patients. Treatment variables were a spot size of 50 microns, exposure duration of 0.1 seconds, and power sufficient to produce barely visible burns in a grid pattern. We treated the thickened retina and non-thickened area of the macula excluding central 500 micron. Microaneurysms within the macular areas were treated by focal application of laser shots sufficient to bleach them.

**Results:** The study comprised 86 eyes of 52 patients who were treated by applying 180 to 360 burns with a mean of 275±51. Mean macular thickness differed significantly between time points (Wilks' Lambda 0.139; F (2, 6) = 125.95; p = 0.00001). Mean visual acuity changed significantly between time points (Wilks' Lambda 0.535; F (4, 82) = 17.8; p = 0.00001). At the last follow-up, visual acuity improved at least one line in 32(37.2%) eyes, remained stable in 48(55.8%) eyes, and declined in 6(6.9%) eyes.

**Conclusion:** Modified mild macular grid is an effective and safe procedure for patients with diffuse diabetic macular oedema.


**Keywords:** Modified mild macular grid, Macular oedema, Diabetes mellitus, Grid laser. (JPMA 66: 537; 2016)

## Introduction

Diabetic macular oedema is reported as the most common cause of moderate vision loss among middle-aged working population.[1] Prevalence of diabetic macular oedema increases with more severe retinopathy.[2] Worldwide prevalence of diabetic macular oedema has been reported to be 6.81%.[3] Grid laser has shown a significant improvement in visual acuity (VA) and prevent moderate visual loss.[4] Classical grid laser has that disadvantage that it can produce visual field defects.[5] Scar formation may extend to the fovea centralis and causes permanent defective vision.[6] Sub-threshold grid laser emerged as a technique to overcome the side effects of classical grid laser.[7] According to the Pakistan National Blindness and Visual Impairment survey,[8] Pakistan will be among the five countries with the highest prevalence of diabetes by 2025. We will be facing a huge burden of patients with diabetic macular oedema because these patents are in their peak of professional achievement and belong to middle-aged group of working population. In the face of acute shortage of eye specialists, particularly retina specialists, we need a treatment modality which is cost-effective and free from side effects.

The current study was planned to evaluate the effects of sub-threshold frequency doubled neodymium yttrium aluminium garnet modified macular grid laser treatment on diffuse diabetic macular oedema in context with reduction of oedema and improvement of VA.

## Patients and Methods

The prospective observational case series was conducted at the Department of Ophthalmology Unit II, Civil Hospital Karachi, and the Department of Ophthalmology, Dow International Medical College, Karachi, from June 2011 to May 2014. After ethical approval was obtained from institutional review committee, we included all patients with type II diabetes mellitus having non-proliferative diabetic retinopathy with diffuse macular oedema involving the whole macula, haemoglobin A1c (HbA1c) less than 10%, no history of hypertension, and VA of at least 6/60 or better on Snellen's visual acuity chart. Informed consent was obtained from all the patients.

We excluded patients with proliferative diabetic retinopathy, previous laser treatment, posterior segment pathologies causing impaired vision, cataract extraction

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within the preceding12 months, significant media opacities and macular ischaemia on fundus fluorescein angiography (FFA).

Ocular examination included best corrected VA using Snellen's VA chart. Slit lamp examination of anterior and posterior segment. Fundus biomicroscopy by contact and non-contact lenses. Applantion tonometry by Goldman's applanation tonometer. The first examination also included fundus photography and FFA. All the eligible patients were treated by a fellow ophthalmologist. Macular grid laser was performed by using a neodymium-doped yttrium aluminium garnet (Nd:YAG) 532nm, frequency-doubled green laser(LightLas 532, Lightmed Corporation, Taiwan). After adequate mydriasis with tropicamide 1% and topical anaesthesia with proparacaine (Alcaine) 0.4% eye drops, an area central is contact lens (Supermacula, Volk, USA) was applied. Treatment variables were a spot size of 50-100microns, exposure duration of 0.05 seconds, and powers between 100MW and 200MW. The desired endpoint was to produce a burn producing barely visible blanching of the retinal pigment epithelium. We applied these mild burns in a grid pattern in thickened retina and non-thickened area of the macula in a grid pattern excluding central 500 micron. Microaneurysms, if present within the macular areas, were treated by focal application of laser shots sufficient to bleach them. About 150 to 300 burns were applied 500 micron away from the foveal avascular zone. Follow-up visits were performed at two-week intervals for two months and then every month after treatment. Patients were released after completingl year of follow-up. At each follow-up visit, we performed refraction to find best corrected VA and stereoscopic fundus biomicroscopy. Those eyes with either increased foveal thickening on fundus examination or persistent foveal thickening and decreased vision were subjected to a supplemental treatment with the same protocol. For supplemental treatment, additional 50 to 150 burns were applied. Optical coherence tomography and FFA were performed at 2 weeks, 3 months, 6 months and 12 months after treatment.

Primary outcome included the reduction or elimination of macular oedema on stereoscopibio microscopy and optical coherence tomography compared with baseline examination at 2 weeks 3 months, 6 months, and 12 months after photocoagulation and the proportion of eyes that experienced a visual gain or loss of one line or more on the Snellen's VA chart. Decimal notation of Snellen's VA was used for statistical analysis. Data was analysed using SPSS 15. Continuous variables were presented as means and standard deviation (SD) while categorical variables as frequency and percentages. One-way repeated measures analysis of variance (ANOVA) was conducted to compare the effect of modified mild macular grid on VA and macular thickness (MT) after two weeks, three months, six months and one year(time points).

## Results

There were 86 eyes of 52 patients; 30(58%) males and 22(42%) females with an overall mean age of 49.7±8.24 years. Two (3.8%) patients had type 1 and 50(96.1%) had type II diabetes mellitus. Mean duration of diabetes was 13.3±6.6 years (range: 1-30 years). Mean number of laser burns was 275±51 (range: 180-360) depending upon the severity of macular oedema, including repetition in 12(14%) eyes.

Mean MT differed significantly between time points (Wilks' Lambda 0.139; F (2, 6) = 125.95; p = 0.00001).Modified mild macular grid laser slightly reduced MT from pre-laser to 2-weeks after laser (340.34±29.45 micron v/s 336.20±31.27 micron, respectively), which was not statistically significant (p= 0.911). However, after 3months, 6 months and I year post-laser it reduced to 277.04±16.00 microns (p=00001), 252.3953±20.03 microns (p=00001) and 259.83±22.13 microns (P=00001) which was statistically significantly different from pre-pre-laser. There was slight increase in MT from 6-month to one-year period (p=0.103) which was statistically not significant (Table-1, Figure-1).

Mean VA changed significantly between time points (Wilks' Lambda 0.535; F (4, 82) = 17.8; p= 0.00001).

**Table-1:** Change in Macualr Thickness (MT) at different times after Modified Mild Macular Grid.

| Time Points | Mean (microns) | Std. Deviation |
|---|---|---|
| MT Pre-laser | 340.3372 | 29.4501 |
| MT at 2 Weeks | 336.1977 | 31.26916 |
| MT at 3 Months | 277.0465 | 16.00287 |
| MT at 6 Months | 252.3953 | 20.0366 |
| MT at 1 Year | 259.8256 | 22.13392 |

**Table-2:** Change in Visual Acuity (VA) at different times after Modified Mild Macular Grid.

| Time Points | Mean VA in decimal points | Std. Deviation |
|---|---|---|
| VA before Laser | 0.4404 | 0.23321 |
| VA at 2 Weeks after Laser | 0.4462 | 0.23154 |
| VA at 3 M onths after Laser | 0.6547 | 0.20479 |
| VA at 6 Months after Laser | 0.8236 | 0.7129 |
| VA at 1 Year after Laser | 0.8009 | 0.71513 |

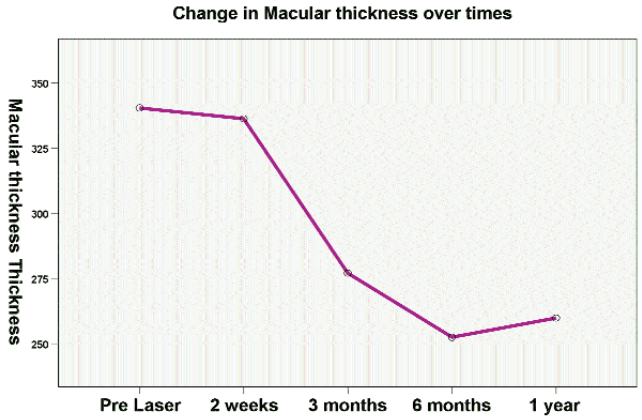


**Figure-1:** Change in Macular Thickness (MT) at different time points.

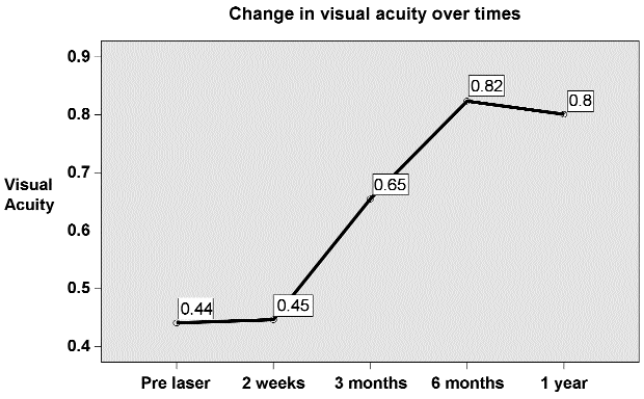


**Figure-2:** Change in Visual Acuity (VA) at different time points.

Modified mild macular grid laser slightly improved VA from pre-laser to 2weeks post-laser (0.4404± 0.23321vs 0.4462±0.23154 decimal points, respectively), which was not statistically significant (p= 0 .935). However, after 3 months,6 months and I year post-laser VA improved to 0.6547±0.20479 decimal points, 0.8236±0.71290 and 0.8009±0.71513, which was significantly different to pre-laser values (Table-2). There was slight reduction in VA from 6-month to one-year period (0.058) which was statistically not significant (p>0.05) (Figure-2).

At the last follow-up, VA improved at least one line in 32(37.2%) eyes, remained stable in 48(55.8%) eyes, and declined in 6(6.9%) eyes. Intraocular pressure did not exceed 21 mmHg in any eye. FFA showed a decrease in the late-onset fluorescein leak in the macula and peri-vascular area in 80(93%) eyes while 6(7%) eyes showed no improvement.

## Discussion

Macular oedema, if treated early by glycaemic control and macular grid, leads to stabilisation of VA. Long-term benefits depend on the glycaemic control and control of other risk factors as well.[9,10] The current study showed a statistically significant decrease in macular oedema at three months and six months of follow-up which remained stabilised at one-year of follow-up in 80(92%) eyes. A mild macular grid initially described by Fong et al. consists of mild intensity burns in a grid pattern extending from 500 to 3000 micron in a grid pattern.[11] In this study, microaneurysms were not treated directly, leaving a major source of leakage at the macula. Therefore, results were not good. In a recent study, when microaneurysms were treated along with mild macular grid, 100% patients exhibited stabilisation of VA.[12] In our study we did the mild macular grid and direct treatment of microaneurysms so we named it Modified Mild Macular Grid (MMMG). Ablation of microaneurysms which results in greater reduction of MT and better visual prognosis.[13] A recent study from Nepal reported improvement of best corrected VA in more than 89% eyes after six months of follow-up when microaneurysms were also treated along with grid laser.[14] A recent study indicates a strong association between formation of microaneurysms and development of clinically significant macular oedema.[15] A more recent study from Japan in which microaneurysms were treated along with macular grid showed reduction in central macular thickness in all patients when followed up over a period of one year.[16] This was the reason we tried to treat these microaneurysms during the follow-up period. Additionally, macular burns leading to irreversible blindness is an established complication of macular photocoagulation.[17] Although intra-vitreal injections of anti-vascular endothelial growth factors like bevacizumab (Avastin) are more popular in the present era, but these are not free from unavoidable complications like endophthalmitis myocardial infarction, stroke and even death in some patents.[18,20] In modified mid macular grid, the only complication is that a novice practitioner can easily burn a macula, leading to irreversible blindness, but this can be avoided by proper training and supervision. In this method only very light burns are applied. If inadvertent laser burns involve the macula, these are so light that they cannot cause irreversible loss of vision.

## Conclusion

Modified mild macular grid is an effective and safe procedure for patients with diffuse diabetic macular oedema. It can be adopted successfully because of its good results and no complications.

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