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Research Article

A RANDOMISED, COMPARATIVE STUDY OF GRID LASER AND SUBTHRESHOLD MICROPULSE DIODE LASER IN THE TREATMENT OF DIFFUSE DIABETIC MACULOPATHY

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ABSTRACT

Objective: Diabetic retinopathy is a major cause of visual impairment in both developing and developed countries. The two important complications are macular edema and proliferative diabetic retinopathy. Laser treatment can reduce vision loss in both proliferative diabetic retinopathy and diabetic macular edema. Early treatment of diabetic retinopathy study shows that immediate laser treatment reduces the risk of moderate visual loss by at least 50%. Thermal tissue damage is the main cause of many potential complications of conventional photocoagulation that may lead to immediate and late visual loss. A subthreshold diode micropulse (SDM) laser targets retinal pigment epithelium (RPE); it is maximally absorbed by the melanosomes of the RPE and underlying choroid while sparing the neurosensory retina. SDM laser minimizes chorioretinal damage as there is no thermal effect or injury despite achieving photocoagulation effects. To compare, the effectiveness of SDM laser versus grid laser photocoagulation for the treatment of clinically significant macular edema in diabetic patients. To study, the outcome and adverse effects of laser treatments in both modalities.

Methods: All Type 2 diabetic patients presenting to the ophthalmology department outpatient department were screened for diffuse diabetic macular edema and 60 eyes were enrolled in the study. They were divided into two groups of 30 eyes each and randomly assigned to receive either conventional grid laser or SDM laser. A detailed clinical examination which included visual acuity, color vision, visual fields (central 10°), fundus photos, and fundus flourescein angiography were done prior to the laser treatment and at 6 weeks and 3 months follow-up.

Results: Conventional grid laser caused a significant resolution of macular edema, angiographically, whereas SDM laser showed worsening at 3 months follow-up. Our study did not show an alteration of central 10° of visual field or color vision defects in both the groups, which suggest significant functional damage is not caused by both treatment modalities. We found in our study that conventional Grid laser was better at 3 months follow-up in improving/stabilizing visual acuity and macular edema (angiographically). A single sitting of grid laser is better than SDM laser in diffuse diabetic maculopathy.

Keywords: Diabetic retinopathy, Diabetic macular edema, Grid laser, Subthreshold micropulse diode laser.

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INTRODUCTION

Diabetic retinopathy is a major cause of visual impairment in both developing and developed countries. The two important complications are macular edema and proliferative diabetic retinopathy. Diabetic maculopathy is caused by edema from leaking micro aneurysms and capillaries. The laser treatment can reduce vision loss in both proliferative diabetic retinopathy and diabetic macular edema. Early treatment of diabetic retinopathy study shows that immediate laser treatment reduces the risk of moderate visual loss by at least 50%.

Thermal tissue damage is the main cause of many potential complications of conventional photocoagulation that may lead to immediate and late visual loss. This includes inadvertent foveal burns, progressive expansion of laser scars. Other complications include paracentral scotomas, choroidal neovascularization, subretinal fibrosis, and vitreous hemorrhage.

The subthreshold diode micropulse (SDM) laser targets retinal pigment epithelium (RPE); it is maximally absorbed by the melanosomes of the RPE and underlying choroid while sparing the neurosensory retina. SDM laser minimizes chorioretinal damage as there is no thermal effect or injury despite achieving photocoagulation effects.

Aims and objectives

- To compare, the effectiveness of SDM laser versus grid laser photocoagulation for the treatment of clinically significant macular edema in diabetic patients
- To study, the outcome and complications of grid laser and SDM laser.

METHODS

All Type 2 diabetic patients presenting to the ophthalmology department outpatient department were screened for diffuse diabetic macular edema, and 60 eyes were enrolled in the study. They were divided into two groups of 30 eyes each and randomly assigned to receive either conventional Grid laser (Group A) or SDM laser (Group B). A detailed clinical examination which included visual acuity, color vision, visual fields (central 10°), fundus photos, and fundus flourescein angiography (FFA) were done prior to laser treatment and at 6 weeks and 3 months follow-up.

Group A patients received laser burns of 200 μ spot size, 0.2 seconds duration and a power of 250-400 Milliwatt and around 200 spots. Power and duration were modified to induce moderate intensity gray to white burns and the same used to complete the grid. Group B patients received laser burns with a power of 820 Milliwatt, 0.2 seconds

duration (15% duty cycle 0.01 seconds on and 0.19 seconds off) spot size of 200 μ and around 1000 spots.

RESULTS

The patients were followed-up 6 weeks and 3 months and their best corrected visual acuity, visual fields, FFA, and color vision were studied and the results documented.

Demography

Sex

Groups	Males	Females
A	16	14
B	17	13

Age

Age	Group A	Group B
40-50	6	6
50-60	16	17
60-70	8	7

Visual acuity

Both groups had comparable visual acuity prior to laser photocoagulation.

Visual acuity	Grid laser (Group a)	SDM laser (Group b)
6/6-6/12	18	20
6/18-6/36	6	6
6/60	4	3
<6/60	2	1

SDM: Subthreshold diode micropulse

Following threshold grid laser photocoagulation in Group A at 6 weeks follow-up, an improvement of more than three lines on Snellen's chart was seen in one eye, improvement in vision by 1-3 lines was observed in 10 eyes, 18 eyes remained static, and worsening in visual acuity was noted in one eye.

At the end of 3 months, 3 eyes showed an improvement in vision of more than three lines and 18 eyes showed an improvement between 1 and 3 lines, 10 eyes remained static, and worsening of vision noted in one eye.

In Group B, following SDM laser photocoagulation at 6 weeks follow-up none of the eyes showed an improvement of more than three lines, an improvement in visual acuity by 1-3 lines was noted in four eyes, 25 eyes remained static, and vision worsened in one eye.

At the end of 3 months, an improvement in visual acuity by more than three lines on Snellen's chart was observed in on eye and by 1-3 lines in 6 eyes, 22 eyes remained static, and worsening of visual acuity was noted in one eye.

Visual acuity	Group A (Grid laser)		Group B (SDM laser)	
	6 weeks	3 months	6 weeks	3 months
>3 lines	1	3	0	1
1-3 lines	10	18	4	6
No improvement	18	8	25	22
Worsening	1	1	1	1

SDM: Subthreshold diode micropulse

Comparative analysis using Chi-square test

Chi-square analysis comparing Group A and Group B at 6 weeks follow-up and 3 months shows:

???	Chi-square	df	p value	Significance
6 weeks	4.7109	3	0.1942	Not significant
3 months	13.5333	3	0.0036	Highly significant

Visual fields

Visual field testing using Appasamy automated perimetry studying the central 10° (No. of points with p<5%) was done in all 60 eyes prior to laser photocoagulation and at 6 weeks and 3 months follow-up.

In Group A, at 6 weeks follow-up 6 eyes showed an improvement in field defects, 12 eyes remained static and worsening of field defects was noted in 10 eyes. At the end of 3 months, 8 eyes showed an improvement in their visual fields, 6 eyes remained static, and 14 eyes worsened.

In Group B, all 30 eyes underwent visual field testing prior to laser treatment and at 6 weeks and 3 month's follow-up. At 6 weeks follow-up, an improvement in field defects was seen in 8 eyes that had prior field defects, 19 eyes remained static, and 3 eyes worsened. At the end of 3 months, 9 eyes showed an improvement in field defects, 13 eyes remained static, and worsening was noted in 8 eyes.

Statistical analysis comparing Groups A and B

NPar tests

Descriptive statistics

Visual fields	N	Mean	Standard deviation	Minimum	Maximum
6 weeks	38	0.68	2.182	–3	6
3 months	35	0.20	2.826	–7	7
Group	60	1.50	0.504	1	2

Mann–Whitney test

Duration	Group	n	Mean rank	Sum of ranks
6 weeks	A	16	17.03	272.50
	B	22	21.30	468.50
	Total	38		
3 months	A	15	14.70	220.50
	B	20	20.48	409.50
	Total	35		

Test statistics

Statistical tests	6 weeks	3 months
Mann-Whitney U	136.500	100.500
Wilcoxon W	272.500	220.500
Z	–1.219	–1.676
p value	0.223	0.094
Exact significant (2* [one-tailed significant])	0.246[a]	0.099[a]

[a]: ???

FFA

FFA did prior to laser treatment and at 6 weeks, and 3 months follow-up was studied by calculating the areas of leaks, i.e. leaks per mm^2 using the standard program available in the Topcon image net professional.

In Group A, (Grid laser) 28 eyes showed a significant decrease in the areas of leaks after laser photocoagulation at 6 weeks follow-up and a further decrease at the end of 3 months. Two patients showed increase in the area of leaks despite laser treatment at both 6 weeks and 3 months follow-up.

In Group B, (SDM laser) 17 eyes showed a decrease in the areas of leakage at 6 weeks following laser treatment, and 13 eyes continued

to maintain this finding at the end of 3 months. An increase in areas of leak was observed in 13 eyes despite laser treatment at 6 weeks which increased to 18 at the end of 3 months.

Comparative analysis

FFA (leaks in mm²)	Groups	Mean	Standard deviation	Standard error mean
6 weeks	A	2.3630	1.85103	0.33795
	B	0.0977	0.73899	0.13492
3 months	A	2.5200	1.93336	0.35298
	B	−0.0953	0.97658	0.17830

FFA: Fundus flourescein angiogram

FFA (leaks in mm²)	t	df	p value
6 weeks	6.225	58	0.000 (highly significant)
3 months	6.613	58	0.000 (highly significant)

FFA: Fundus flourescein angiogram

Color vision

All 60 eyes included in the study did not have any significant color vision defects prior to laser photocoagulation and in the follow-up period of 6 weeks and 3 months.

Improvement in visual acuity was highly significant by statistical analysis in Group A compared to Group B. Our study differs from other studies by showing a statistically significant improvement in visual acuity following conventional threshold grid laser as compared to SDM laser. SDM laser showed a predominant stabilization of visual acuity rather than improvement in our study.

Conventional grid laser caused a significant resolution of macular edema, angiographically, whereas SDM laser showed worsening at 3 months follow-up. Our study did not show an alteration of central 10° of visual field or color vision defects in both the groups, which suggest significant functional damage is not caused by both treatment modalities.

CONCLUSION

We found in our study that conventional Grid laser was better at three months follow-up in improving/stabilizing visual acuity and macular edema (angiographically). A single sitting of grid laser is better than SDM laser in diffuse diabetic maculopathy.

The significant functional difference by field analysis and color vision was not seen between the two groups.

Further studies to compare single sitting Grid laser photocoagulation versus multiple sitting SDM laser can be done and long term follow-up will also help to identify the role of SDM laser in the treatment of diabetic macular edema.

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