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

VIKRAM CHELLAKUMAR*, RAJARATHNAM, CORNELIUS VIJAI
Department of Ophthalmology, Sri Balaji Medical College and Hospital, Chennai, Tamil Nadu, India.
Email: vikramchellakumar@yahoo.co.in.
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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 fluorescein 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.

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 microaneurysms 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 fluorescein 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...
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

<table>
<thead>
<tr>
<th>Groups</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>B</td>
<td>17</td>
<td>13</td>
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</table>

Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-50</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>50-60</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>60-70</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>

Visual acuity

Both groups had comparable visual acuity prior to laser photocoagulation.

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 photo-coagulation 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

<table>
<thead>
<tr>
<th>Visual fields</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 weeks</td>
<td>38</td>
<td>0.68</td>
<td>2.182</td>
<td>-3</td>
<td>6</td>
</tr>
<tr>
<td>3 months</td>
<td>35</td>
<td>0.20</td>
<td>2.826</td>
<td>-7</td>
<td>7</td>
</tr>
<tr>
<td>Group A</td>
<td>60</td>
<td>1.50</td>
<td>0.504</td>
<td>1</td>
<td>2</td>
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</table>

Mann–Whitney test

Duration

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean rank</th>
<th>Sum of ranks</th>
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</thead>
<tbody>
<tr>
<td>6 weeks</td>
<td>A</td>
<td>16</td>
<td>17.03</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>22</td>
<td>21.30</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>A</td>
<td>15</td>
<td>14.70</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>20</td>
<td>20.48</td>
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<tr>
<td>Total</td>
<td></td>
<td>35</td>
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</table>

Test statistics

<table>
<thead>
<tr>
<th>Statistical tests</th>
<th>6 weeks</th>
<th>3 months</th>
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</thead>
<tbody>
<tr>
<td>Mann-Whitney U</td>
<td>136.500</td>
<td>100.500</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>272.500</td>
<td>220.500</td>
</tr>
<tr>
<td>Z</td>
<td>-1.219</td>
<td>-1.676</td>
</tr>
<tr>
<td>p value</td>
<td>0.223</td>
<td>0.094</td>
</tr>
<tr>
<td>Exact significant</td>
<td>0.246*</td>
<td>0.099*</td>
</tr>
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</table>

FPA 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 mm² 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**

<table>
<thead>
<tr>
<th>FFA (leaks in mm²)</th>
<th>Groups</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Standard error mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 weeks</td>
<td>A</td>
<td>2.3630</td>
<td>1.85103</td>
<td>0.33795</td>
</tr>
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<td></td>
<td>B</td>
<td>0.0977</td>
<td>0.73899</td>
<td>0.35298</td>
</tr>
<tr>
<td>3 months</td>
<td>A</td>
<td>2.5200</td>
<td>1.93536</td>
<td>0.35298</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>-0.0953</td>
<td>0.97658</td>
<td>0.17830</td>
</tr>
</tbody>
</table>

**CONCLUSION**

We found in our study that conventional Grid laser was better at three modalities. 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 deficits in both the groups, which suggest significant functional damage is not caused by both treatment modalities.

**REFERENCES**