A histological comparison of micropulse and standard laser treatment in threshold and sub-threshold mode

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BACKGROUND:
Laser photocoagulation is a common treatment option for diabetic macular edema, but may damage the neurosensory retina. Sub-threshold micropulse laser produces therapeutic effects without inducing detectable clinical changes. However, sub-threshold standard laser (continuous wave) can induce detectable changes in optical coherent topography. We aim to compare the effects of sub-threshold 577nm micropulse, 577nm laser and 532nm laser in standard mode on the rabbit retina by histological examination.

METHODS:
Twelve 3-month-old Dutch-belted rabbits received laser treatment in their left eyes (Table 1). The 532nm (SUPRA™, Quantel Medical) and 577nm (SUPRA SCAN 577™, Quantel Medical) laser photocoagulation in standard mode were performed in six rabbit left eyes. The other six rabbits received sub-threshold 577nm micropulse laser photocoagulation at 5% and 10% duty cycle (DC). Treatment was given at threshold and sub-threshold (approximately 50% to threshold power) in areas superior and inferior to the medullary ray in the rabbit retina (Figure 1).

At 1 week and 1 month post-laser photocoagulation, rabbits were sacrificed and the left eyes were enucleated and fixed with Davidson’s fixative, dehydrated, and finally embedded in paraffin wax. Retinal sections (6 µm) were prepared along the laser-treated area and stained with haematoxylin & eosin (H&E). Histology of the retinal sections was analyzed and compared.

Table 1. Number of rabbits treated with different types of laser photocoagulation in left eyes

<table>
<thead>
<tr>
<th>Type of laser treatment</th>
<th>1 week</th>
<th>1 month</th>
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<tbody>
<tr>
<td>5% DC micropulse laser at superior</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10% DC micropulse laser at inferior</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>532nm laser at superior</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>577nm laser at inferior</td>
<td>3</td>
<td>3</td>
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</table>

Figure 1. photo indicating the area of laser photocoagulation

RESULTS:

In the retinae treated in threshold mode, extensive retinal damage was present with all 4 treatment modalities.

In the sub-threshold treated areas, the retinae treated by 532nm laser photocoagulation in standard mode exhibited the most retinal morphological changes than the ones treated by 577nm laser in standard mode at either 1 week or 1 month post-laser treatment.

Increased extent of retinal fold, retinal pigment epithelium disruption and outer retinal cell death occurred. An almost complete collapse of the choroidal layer was observed.

In general, the overall appearance of the retinae treated with 577nm micropulse laser in both 5% and 10% DC were better preserved when compared with the ones using standard setting with either 577nm or 532nm lasers.

Most importantly, the cellular morphology appeared best preserved in the retinae using the 5% duty cycle, with slight or minimal disruption by histological examination.

CONCLUSIONS:
This study confirmed the clinical findings that no matter what modality is used, if there were a threshold treatment, extensive retinal damage occurs. However, by reducing power to 50% of threshold power, less damage was incurred by using the 5% duty cycle micropulse laser.

REFERENCES:

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