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Research article

Subthreshold Micropulse Laser Treatment in Diabetic Macular Oedema

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Abstract

Purpose: To study the effect of micropulse MP laser treatment in patients with diabetic macular oedema DMO over a three months period.

Method: It's a retrospective study of 80 patients with DMO, these patients are outside the treatment criteria for anti-VEGF injections, that's to say their best corrected visual acuity BCVA is better than 6/12, and/or the central macular thickness CMT is less than 400 micrometre. We measured there BCVA, CMT before and three months after MP laser treatment. We used coloured photographs, fundus autofluorescence FAF, and optical coherent tomography OCT to highlight and marks left on the retina after treatment.

Results: At three months 43 of the patients improved their BCVA, 25 worsened. CMT showed improvement in 43 of the patients and worsened in 36. Retreatment was not done on any of them using the 3 months. No one of the patients had any laser scars or marks detected on biomicroscopy, FAF or OCT scans.

Conclusion: MP laser treatment is an effective, affordable way of treating patients with DMO not meeting the treatment criteria of anti-VEGF injections.

Keywords: *Micropulse Laser (MP Laser); Central Serous Retinopathy (CSR); Diabetic Macular Oedema (DMO); Retinal Vein Occlusion (RVO)*

Introduction

Micropulse Laser (MP laser) is an alternative to conventional continuous wave laser in treating retinal diseases including central serous retinopathy (CSR), diabetic macular oedema (DMO), or macular oedema secondary to retinal vein occlusion (RVO). Treatment with MP laser is not associated with thermal retinal damage, this fact is particularly important in treating pathologies near the fovea.

This review highlights MP laser treatment in patients with DMO.

The principle for laser photocoagulation and micropulse laser treatment.

Laser photocoagulation (LPC) has been used for many years in treating retinal conditions particularly DMO. Laser interaction with the retinal tissue depends on the wavelength, pulse duration and irradiance (energy per area).

There are two main theories in explaining laser action on the retina: the first theory implies better oxygenation of the retina, destruction of some of the photoreceptors improves oxygenation of other parts of the retina, by that vascular endothelial growth factors production would be diminished. In addition, laser scars would act as bridges to conduct 3 oxygen from the choroid to the retina, improving its oxygenation.

The second theory implies that the introduction of laser scars provokes the production of 'heat shock proteins' by the surrounding healthy retina, this immunomodulation of the cell function promotes repair process.

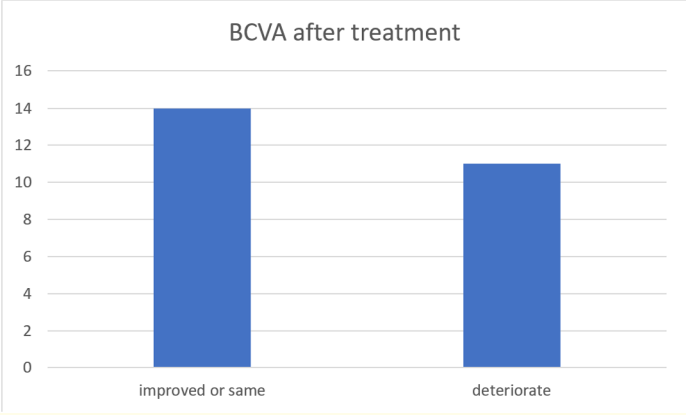


Figure 1

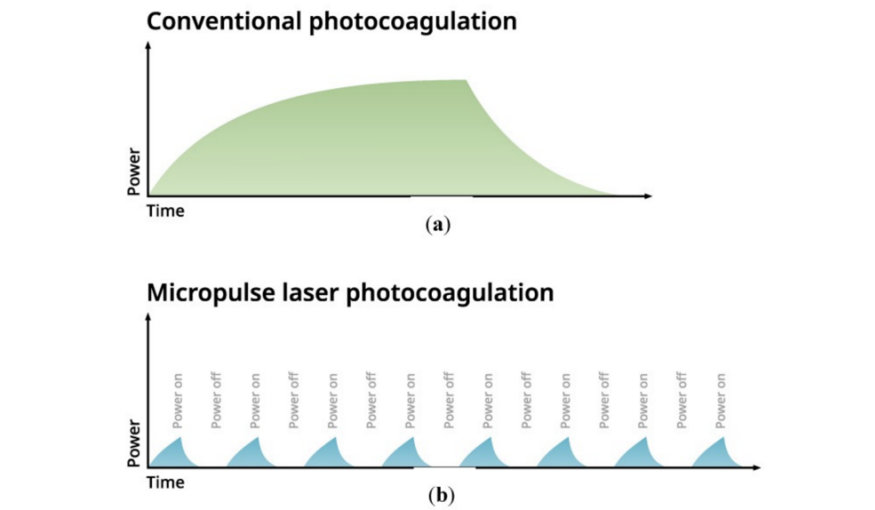
This theory is the principle of the MP laser treatment, achieving therapeutic effect without destroying the retina. The MP laser is an additional feature of the commercially available lasers of wavelengths 532 nm, 577 nm and 810 nm. The impact of the laser is divided into many repetitive short impulses measured in microseconds, in between these periods there will be time allows the retina to cool down. The effective time of the laser action is called the duty cycle, and in retinal diseases is 5% of the cycle that is 0.2 second duration of exposure envelope.

The idea of using the MP laser is not to have any marks on the retina, no scars or marks are detected on biomicroscopy, fundus autofluorescence FAF, fundus fluorescence angiography FFA or optical coherent tomography OCT [1].

Materials and Methods

Setting: The ophthalmology outpatient department at Ashford and St. Peters Hospitals NHS Foundation Trust.

Methods: This was a retrospective study of 80 eyes with DMO treated with MP laser, who did not meet the threshold for antiVEGF treatment, during the 2018/2019 period. The national criteria is a VA of better than 6/12 and/or CMT of less than 400 micrometres. BCVA and CMT data was taken pre treatment and at follow up periods of 3 - 6 months. We took a fundal photograph, FAF and an OCT to detect any laser marks left on the retina. We documented any other method of treatment implicated during this period whether another MP laser treatment was given or anti-VEGF.



(**a**,**b**) Mechanism of action of continuous wave laser versus subthreshold micropulse laser treatment (SMPLT). (**a**) In application of continous wave laser the power is distributed evenly within the duration of an impact. (**b**) In SMPLT, laser impact is delivered in a train of short impulses between which there are intervals that enable retinal tissue to cool down.

Figure 2

Treatment involves subthreshold micropulse yellow laser photocoagulation at 5% of a cycle at reduced energy level from the micropulse laser treatment burns. Laser exposure time was 0.2 second, spot diameter was 100 microns.

Inclusion criteria was any amount of DMO with BCVA better than 6/12 and/or CMT less than 400 micron.

Primary outcome is the change of BCVA over 3 months period. Secondary outcome is the change in CMT, other treatment given to the patient, any mark left in the retina after treatment.

Secondary outcome is the mean change of central macular thickness CMT over 3 months, detection of laser marks over the retina, number of MP laser treatment needed, other ways of treating DMO afterwards.

Results

Study population: 80 patients, 54% (43) were female and 46% (37) were male. Age of patients is between 60 - 85 years, average 63.4 years.

After 3 months of the treatment, out of the 80 patients treated, 25 (31.25%) patients had a gain in letters, 21 (26.25%) patients had a reduction in letters and the remaining 34 (42.5%) patients had no change. Average letter gain was 11.37 letters. Average letter lost was 10 letters.

CMT change improved in 43 patients (53.75%), worsened in 25 (31.25%) of patient, and was unchanged in 12 patients (12%) of the patients.

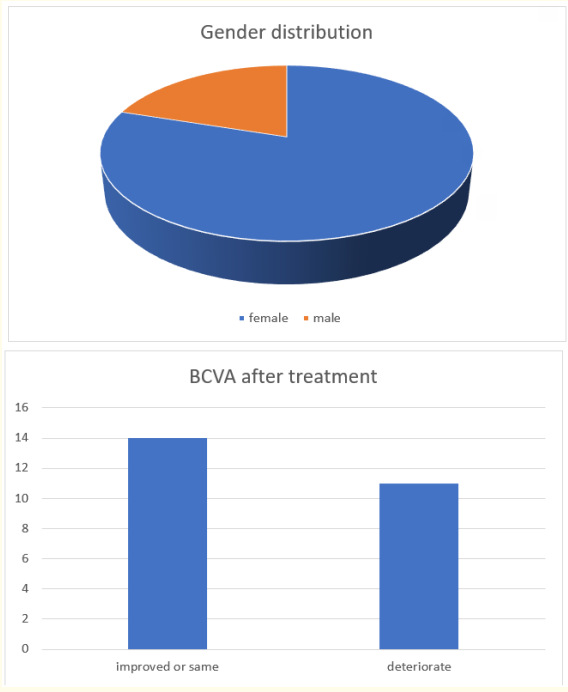


Figure 3

Discussion

Many types of laser treatment have been tried to control DMO. Although diode laser leaves no visible scars into the retina but histologically, they can cause retinal and choroidal damage the same way Argon laser does. Argon laser leaves damage to the retina with permanent scars and visual loss. Many studies, a pilot study was conducted at Moorfield's eye Hospital in 1999, it showed that MP laser was effective in treating DMO in up to 56% of their cases [2,3]. In 50% of the cases retreatment was required within 6 month time.

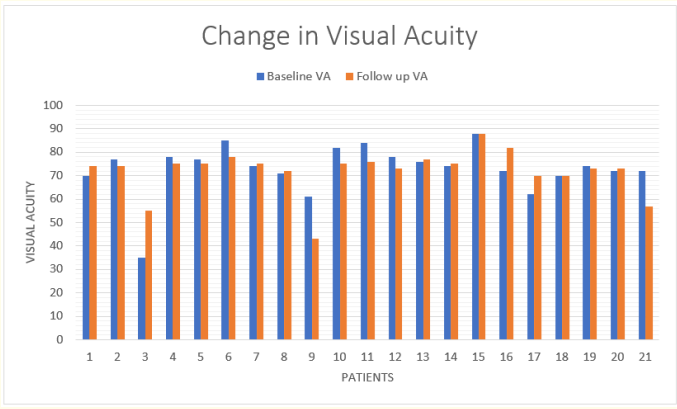


Figure 4

Conclusion

MP laser is an effective, non- destructive way of treating selective cases of DMO. MP laser is a cheap, safe non unpleasant way of treating macular oedema. It has high efficacy in treating DMO and it could be used as first line therapy. There was no evidence of retinal damage after treatment. The BCVA didn't improve much probably because of a short follow-up time, as the covid-19 pandemic occurred, and hospitals were closed for routine follow-up.

Panretinal photocoagulation with MP laser is yet another implication, it's still under research, however.

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