

THE ROLE OF FREQUENCY-DOUBLED ND:YAG LASER (532 NM) IN THE TREATMENT OF DIABETIC MACULAR EDEMA

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SUMMARY – The aim of the study was to compare various laser wavelengths for photocoagulation treatment in clinically significant (focal) macular edema (CSME) in diabetics. Two different laser wavelengths (frequency-doubled Nd:YAG-532 nm *vs.* argon green-514 nm) were used to treat 54 eyes (28 eyes were treated with double frequency Nd:YAG laser and 26 eyes were treated with argon-green laser) of 35 patients with diabetes mellitus type 2. The mean follow up was 6 months. Therapeutic effect was evaluated by repeat visual acuity testing, color fundus photography and fundus fluorescein angiography. Reduction/elimination of CSME was observed in 73% (n=19) of frequency-doubled Nd:YAG-treated eyes and 75% (n=21) of argon-treated eyes. These results indicate that frequency-doubled Nd:YAG laser (532 nm) is equivalent to argon-green (514 nm) laser in the treatment of CSME. Frequency-doubled Nd:YAG laser (532 nm) therapy is effective in the treatment of CSME in diabetics and has a number of advantages (less scattering and less absorption by macular xanthophyll, ergonomic, high optical efficiency, long operating life-time, etc.).

Key words: *diabetic macular edema, laser coagulation, treatment outcome, comparative study*

Introduction

Diabetic macular edema (DME) is a common manifestation of diabetic retinopathy and the leading cause of legal blindness in patients with type 2 diabetes¹. DME occurs after breakdown of the blood-retinal barrier because of leakage of dilated hyperpermeable perfoveal retinal capillaries (diffuse edema) and from microaneurysms (focal edema)². The Early Treatment Diabetic Retinopathy Study (ETDRS) showed focal laser photocoagulation (LP) to be beneficial treatment for focal leakage from microaneurysms and grid LP for diffuse capillary leakage³. Today there are many ophthalmologic lasers available on the market. Both frequency-doubled Nd:YAG laser (532 nm) and argon green laser (514

nm) have the advantage of good absorption in the retinal pigment, low absorption on macular xanthophyll with consecutively reduced risk of neuroretinal damage, and high absorption in oxyhemoglobin in microaneurysms⁴. As these are two most widely used lasers in ophthalmologic practices, we wanted to compare these two laser types in the treatment of focal DME.

Patients and Methods

Thirty-five patients (54 eyes) with type 2 diabetes referred to the University Department of Ophthalmology, Split University Hospital in Split, Croatia, for laser therapy were recruited for this prospective study. All eyes had clinically significant diabetic macular edema (CSME) according to ETDRS definition⁵. Only patients with focal CSME⁶ and those who had no history of laser treatment for diabetic retinopathy were enrolled. Patients with pure ischemic maculopathy were excluded.

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Table 1. Patient data

No. of patients	35
No. of eyes	54
Male	16
Female	19
Age range (yrs)	57-81
Mean age (yrs)	67.4

Table 1 shows demographic data of study patients. Baseline examination included best corrected visual acuity using Snellen chart, fundus slit lamp biomicroscopy, indirect stereoscopic ophthalmoscopy with 90 D lens, fundus photography centered on the macula, and intravenous fluorescein angiography (FA).

After randomization, laser photocoagulation was applied using either argon green laser (26 eyes) (Argus, Aesculap Meditec GmbH, Germany), emitting at 514 nm, or frequency-doubled Nd:YAG laser (28 eyes) (Visulas 532s, Zeiss, Germany), emitting at 532 nm. The photocoagulation procedure was done using Volk area centralis (90 D) contact lens with previous adequate mydriasis with tropicamide 1% and topical anesthesia. Treatment variables were, for argon laser: spot size 50-100 μ m, exposure duration of 0.1 second, and power between 200 and 500 mW; and for diode laser: spot size 50-100 μ m, exposure duration of 0.1 second, and power between 180 and 460 mW. A single surgeon delivered laser treatment to all study patients. Control examinations were done at 1, 3 and 6 months of laser photocoagulation.

Treatment results were evaluated by assessing visual acuity, fundus slit lamp biomicroscopy and presence of macular edema on FA at follow up.

Statistical analysis was done using the Statistica 6.0 (StatSoft, USA) software. Mann-Whitney U test was used to compare the effect of two different lasers on visual acuity.

Results

Improvement of visual acuity was found in 15 (53.57%) eyes, 7 (25%) remained stable, and 12 (21.43%) showed inferior deterioration of visual acuity in argon treated eyes. Visual acuity improved in 14 (53.84%), remained unchanged in 6 (23.08%) and was deteriorated in 6 (23.08%) eyes in the frequency-doubled Nd:YAG treated group (Fig. 1). Statistical analysis showed that there was no significant difference in visual acuity before and after laser photocoagulation treatment with ei-

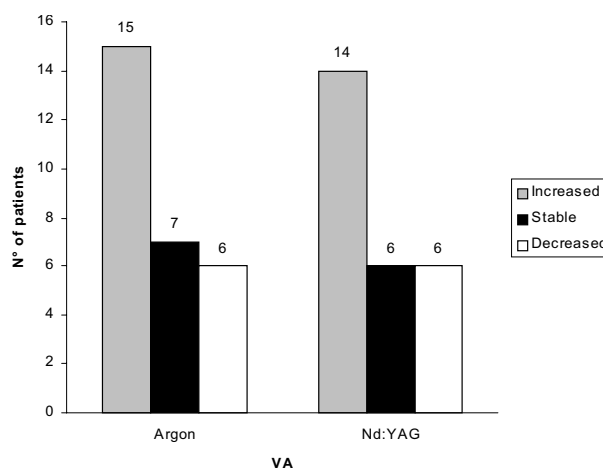


Fig. 1. Number of patients with improved, stable or decreased visual acuity (VA) after treatment with argon and Nd:YAG lasers.

ther of lasers (Mann-Whitney U test, $Z=-0.17$; $p=0.86$). The best improvement in vision was up to 4 Snellen lines in patients treated with argon laser and 3 Snellen lines in patients treated with Nd:YAG laser.

Reduction/elimination of CSME was observed in 73% ($n=19$) of frequency-doubled Nd:YAG-treated eyes and 75% ($n=21$) of argon-treated eyes. Changes in FA results also showed no statistically significant difference in photocoagulation therapy outcome between the two types of lasers used in this study (Mann-Whitney U test, $Z=-0.12$; $p=0.90$) (Fig. 2). Only two patients with macular edema confirmed on FA had unchanged visual acuity after the treatment and the rest had deterioration of visual acuity. One of the former was from the argon laser treatment group and frequency-doubled Nd:YAG laser treatment group each. All patients who had improve-

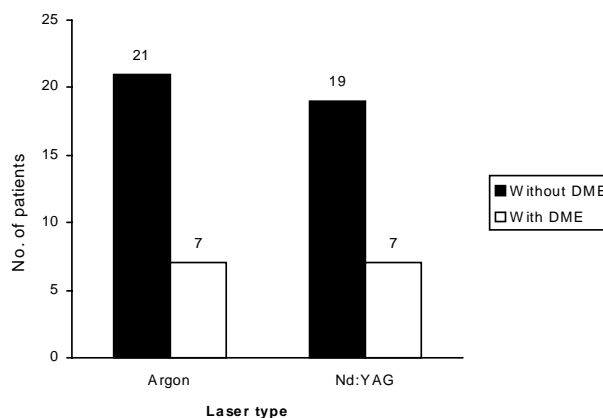


Fig. 2. Number of patients with or without diabetic macular edema (DME) treated with Argon or Nd:YAG lasers.

ment or at least stabilization of visual acuity after the treatment (except for the two patients mentioned above) had no macular edema on control FA.

Discussion

The use of argon laser photocoagulation reduces the risk of significant visual loss due to macular edema by 50% or more³. In our study, comparison between argon and frequency-doubled Nd:YAG lasers revealed no statistically significant difference in terms of improvement or worsening of visual acuity and reduction and/or elimination of macular edema on fundus FA. A few pilot studies demonstrated clinical efficacy of frequency-doubled Nd:YAG laser in the treatment of CSME in diabetics. Reduction/elimination of CSME was observed in 93.3% of argon-treated eyes and 92.9% of Nd:YAG treated eyes with no statistically significant between group differences in the study by Gupta *et al.*⁷. Saeed *et al.* report that macular edema resolved either completely or partly in 80% of eyes and visual acuity was improved or stabilized in 93% of eyes treated with frequency-doubled Nd:YAG laser⁸. The results of treatment of macular edema with argon laser and frequency-doubled Nd:YAG laser are comparable in efficacy.

Conclusion

Both lasers (frequency-doubled Nd:YAG-532 nm and argon green-514 nm) are equally effective in reducing/eliminating CSME and improving/stabilizing visual acuity. Frequency-doubled Nd:YAG laser (532 nm) therapy is effective in the treatment of DME and has a number

of advantages (ergonomic, high optical efficiency, long operating life-time, high portability, etc.). The 532 nm wavelength of frequency-doubled Nd:YAG laser is some longer than 514 nm of argon-green, it may possibly be less absorbed by xanthophylls, and causes less damage to the nerve fiber layer.

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Sažetak

ULOGA FREQUENCY-DOUBLED Nd-YAG LASERA (532 nm) U LIJEČENJU DIJABETIČNOG MAKULARNOG EDEMA

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Cilj studije bio je usporediti različite valne duljine lasera rabljenih za fotokoagulacijsku terapiju kod klinički značajnih (fokalnih) makularnih edema u dijabetičara. Rabili smo dvije različite valne duljine lasera (frequency-doubled Nd:YAG-532 nm i argon green-514 nm) kod 54 očiju (28 očiju liječeno je frequency-doubled Nd:YAG laserom, a 24 oka su liječena argon-green laserom) u 35 bolesnika sa šećernom bolešću tip 2. Srednje vrijeme praćenja bilo je 6 mjeseci. Učinkovitost terapije smo procijenili ponovljenim ispitivanjem vidne oštine, fotografiranjem u boji fundusa i fluoresceinskom angiografijom. Smanjenje/nestanak klinički značajnih makularnih edema zabilježeno je u 73% (n=19) bolesnika liječenih frequency-doubled Nd:YAG laserom i 75% (n=21) bolesnika liječenih argon-green laserom. Ovi rezultati pokazuju da frequency-doubled Nd:YAG laser (532 nm) ima jednaku učinkovitost kao i argon-green laser (514 nm) u liječenju klinički značajnog makularnog edema. Frequency-doubled Nd:YAG laser je učinkovit u liječenju klinički značajnog makularnog edema u bolesnika sa šećernom bolešću i ima niz prednosti (manje rasipanje i manja apsorpcija u makularnom ksantofilu, veća ergonomija, visoka kakvoća optike, dugotrajnost itd.).

Ključne riječi: *dijabetični makularni edem, laserska koagulacija, terapijski ishod, usporedbena studija*

