Evaluation of Chronic Central Serous Chorioretinopathy after Subthreshold Yellow Micropulse Diode Laser Photostimulation at a Wavelength of 577 nm

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Abstract

Objective: This study evaluated the efficacy and safety of subthreshold yellow diode-laser micropulse 577 nm (SDM) in the treatment of chronic central serous chorioretinopathy (CSCR).

Methods: 40 eyes of 40 patients with non-resolving CSCR of >12 months duration were treated with SDM yellow laser (577 nm). Best corrected visual acuity (BCVA) and intraocular pressure (IOP) were measured. Amsler grid screening, ophthalmoscopy, fundus autofluorescence (FAF) and SD-OCT were performed. Follow up measurements were recorded from 3 to 12 months.

Results: Restoration of normal macular anatomy was obtained in 85.7% of cases with a significant reduction in mean central foveal thickness (CFT). Mean visual acuity gain was 14.95 ETDRS letters, subjective or objective deterioration after treatment was not recorded in any case.

Conclusion: The possibility of favouring reabsorption of subretinal liquid by stimulating the retinal pigment epithelium, even at the fovea, without damaging retinal tissue, opens up new frontiers for the therapy of chronic CSCR.

Keywords: Central serous chorioretinopathy; Micropulse diode laser 577 nm; Fundus autofluorescence; Optical coherence tomography

Introduction

Central Serous retinopathy or Chorioretinopathy (CSCR) is an idiopathic disease of the external blood-retina barrier [1] affecting the macular region of the retina. It involves limited detachment of the neuroepithelium (NE), sometimes associated with serous detachment of the Retinal Pigment Epithelium (RPE) [2]. The disorder is sporadic and generally unilateral, though it may affect both eyes more or less symmetrically [3]. It is more frequent in young adult males of anxious disposition [4]. Women with CSCR have a mean age higher than men. The most common symptoms are blurred or distorted vision. Aetiology is unknown, however onset and worsening have been associated with predisposing factors, such as emotional stress, arterial hypertension, organ transplant, gastroesophageal reflux, alcohol abuse, oral or inhaled steroid therapy, pregnancy and systemic diseases, such as lupus erythematosus and Cushing syndrome [5]. Acute CSCR tends to be self-limiting with absorption of the subretinal liquid within 3-5 months and complete or almost complete recovery of visual acuity. Persistence of diminished colour and contrast perception and relapses has been reported in the literature. CSCR may also become persistent, with detachment of the neuroepithelium for more than 5-6 months, healing spontaneously in about 8-12 months (subchronic CSCR). In a minority of cases, especially patients over 50 years of age, the disease may become chronic, permanently impairing visual acuity. In these cases the RPE may show chronic alterations (subneuroepithelial granulation tissue) and new blood vessels may form in the choroid [3]. Cases with a single, well-defined extrafoveal leakage point or RPE detachment can be treated by photocoagulation with a continuous wave green 532 nm laser [6-8]. This therapy is not indicated in cases with foveal leakage or multiple leakage points [9]. Retinal photocoagulation involves destruction of retinal tissue and may stimulate neovascularization, induce localized scotoma, or reduce contrast sensitivity and colour perception [10-15]. Photodynamic therapy (PDT) [16-20], indicated in cases with leakage points next to or under the fovea and in chronic forms, is another option not without possible side-effects, such as RPE atrophy and localised scotoma. Recent studies proposed the use of half-dose PDT alone [21,22] or followed by subthreshold micropulse laser, a new form of diode laser therapy that utilizes multiple shots of very short duration, usually at wavelength either of 810 nm or 577 nm, minimizing thermal damage to the surrounding structures, particularly the neurosensory retina [23-26]. The possibility of favouring reabsorption of subretinal liquid by stimulating the RPE, even at the fovea, without damaging retinal tissue, has opened new frontiers in CSCR therapy [24-26]. Our therapeutic option for CSCR was subthreshold yellow diode laser micropulse photostimulation (SDM) at a wavelength of 577 nm (IQ-577, Iridex Corporation, USA).
Mountain View, CA), selective for RPE [27-29]. Aim of this prospective nonrandomized study is to evaluate the efficacy and safety of SDM 577 nm in 40 patients affected by chronic CSCR [27-31].

Materials and Methods

40 patients, 27 males and 13 females, with an average age of 50.38 years, diagnosed with CSCR, came to our attention at different times. Symptom history was from a minimum of 2 and a maximum of 9 years (mean 3.92); 5 eyes underwent previous intravitreal therapy with bevacizumab and 3 of these were also treated with photodynamic therapy and verteporfin, 2 patients were treated with argon laser photocoagulation in addition to the therapies described previously. One patient had argon laser photocoagulation only and all the rest of the cohort had received oral therapies (diuretics, NSAIDS or both). None of the patients experienced improvement as a result of these previous therapies, even for a brief period, and all were free from any treatment for a minimum of 3 months. All patients complained of distorted vision, difficulty in reading and loss of visual acuity. The best corrected visual acuity (BCVA) was measured; applanation tonometry was performed with a Goldmann tonometer and also Amsler test. Symptom history was from a minimum of 2 and a maximum of 9 years, diagnosed with CSCR, came to our attention at

Results

Collected data before treatment and at the follow-up are described in Table 1. Statistical analysis was carried out by Student's t-test for paired data. p-values of ≤ 0.01 were considered statistically significant as showed in Statistical Analysis and in Figures 1a and 1b. Subjective or objective measurable deterioration after treatment was not recorded in any case. None of the patients complained of pain during treatment or follow-up. Five patients (12.5%), three men and two women, had to be retreated after six months and, among them, two men (7.5%) did not obtain resolution of CSCR at 12 months.

<table>
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<th>Observation period, years</th>
<th>Initial BCVA (ETDRS letters)</th>
<th>Final BCVA (ETDRS letters)</th>
<th>Change in BCVA (ETDRS letters)</th>
<th>Initial CFT µm</th>
<th>Final CFT µm</th>
<th>Change CFT µm</th>
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Table 1: Data summary; (1) Retreatment after 6 months, then resolution; (2) Relapse at 12 months follow up

### Statistical Analysis

#### Baseline (mean values)
- **BCVA:** 76.88 ± 14.81 ETDRS letters (range 100-50, median 82.5);
- **IOP:** 17.8 mmHg;
- **SD-OCT:** mean central foveal thickness (CFT) 390.85 ± 102.23 µm (range 200-599, median 444.50); neuroepithelial detachment (NED) in 40 eyes (100%), retinal pigment epithelium detachment (RPED) in 12 eyes (30%), foveal detachment (FD) in 37 eyes (92.5%), subneuroepithelial granulation tissue (SNGT) in 35 eyes (87.5%), irregular macular profile in 40 eyes (100%);
- **Amsler test:** positive, distorted vision;
- **FAF:** hyperautofluorescence of fundus in area affected by CSCR in 100% of sample

#### 12 months follow up after SDM photostimulation (mean values)
- **BCVA:** 93.62 ± 9.73 ETDRS letters (Δm +14.95, +37.73%; range 100-50, median 96) (p<0.001);
- **SD-OCT:** mean CFT: 253.3 ± 22.62 µm (Δm -137.55 µm, -35.19%; range 162-477 µm, median 233.0 µm) (p<0.001); residual NED in 5/40 eyes (12.5%), residual RPED in 3/12 eyes (25%), FD in 3/37 eyes (8.1%), SNGT in 3/35 eyes (8.5%), altered neuroepithelial morphology and/or reflectance in 5/40 (12.5%), normal macular profile in 37/40 (91.5%);
- **IOP:** 17.6 mmHg (Δm -0.09 mmHg);
- **Amsler test:** negative in 35/40 eyes (87.5%);
- **FAF:** reduced hyperautofluorescence of fundus in area affected by CSCR in 38/40 eyes (95%), hypoautofluorescence of fundus in photostimulated areas in 5/40 eyes (12.5%);
- **SD-OCT:** residual NED in 5/40 eyes (12.5%), residual RPED in 3/12 eyes (25%), FD in 3/37 eyes (8.1%), SNGT in 3/35 eyes (8.5%).
Photostimulation of the RPE cell layer reactivates its fundamental activity with the reabsorption of residual subretinal liquid, typical of CSC. The Iridex IQ-577 in micropulse mode emits a fractionated flow of energy in a train of brief impulses, the duration and interval of which limit the spread of heat into adjacent tissues, allowing extra time for cooling. The laser does not leave any SD-OCT or ophtalmoscopically detectable trace of its action on the retina, either during or after treatment [33-35]. The laser wavelength of 577 nm has its highest coefficient of absorption in melanin and oxyhemoglobin, present in the RPE and choroid capillaries, and is only minimally absorbed by xanthophylls of the innermost layers of the macular region. This may explain its selectivity for the RPE, and beneficial biological intracellular effects [36-40]. Photostimulation of the RPE reactivates cell metabolism by unclear mechanisms, probably involving production of growth factors (VEGF, PEDF). The possibility to treat CSCR with subfoveal leakage points without causing functional damage opens a new era of non-invasive retinal treatment [41]. At 12-months follow-up all patients had no SD-OCT evidence of neuroretinal alterations. Treatment improved vision and no side effects were recorded in any patient. In conclusion, latest generation IQ-577 aims to elicit cell and molecular changes in the RPE29 for the purpose of restoring homeostasis and physiological stability in the tissues, without resorting to their destruction or damage as demonstrated by SD-OCT evaluation [37,41]. If long-term randomised studies will confirm treatment efficacy, it will be possible to replace current therapeutic procedures, potentially deleterious for retinal tissue, with SDM 577 nm photostimulation.

### References


### Conflict of Interest

The authors have no financial or conflicts of interests to disclose.


