ORIGINAL ARTICLE

# Sub-Threshold Micro Pulse Laser (810NM): Treatment for Chronic Central Serous Retinopathy

Mariam Shamim Kashif[1], Najia Uzair[2], Lubna Feroz[3], Asaad Mehmood[4]
[1-4]Department of Ophthalmology, Layton Rahmatullah Benevolent Trust Eye Hospital, Lahore

## ABSTRACT

**Purpose:** To find the effectiveness of sub-threshold (810nm) micropulse diode laser treatment (SMT) in chronic central serous retinopathy (CSR).

**Study Design:** Interventional case series.

**Place and Duration of Study:** Layton Rahmatulla benevolent trust eye hospital, from April 2019 to July 2020.

**Methods:** The patients of chronic CSR (≥ 6 months) participated in the study. We used Spectral Domain Optical coherence tomography (SD-OCT) to record baseline central retinal thickness (CT). Best corrected visual acuity (BCVA) was recorded with Snellen's chart and converted to Log MAR for statistical analysis. All patients underwent treatment with sub-threshold laser (810nm) in micropulse mode with 5% duty cycle (DC).

**Results:** Twenty five eyes with chronic CSR were enrolled in the study. The patients were treated with laser and final assessment was made at 6 months. Mean BCVA at presentation was 0.46 Log MAR ± 0.12 and a mean baseline CT of 362.2 µm ± 32.6µm. At final follow-up there was a mean decrease in CT of 97.2 µm ± 21.8 from the baseline. After treatment mean BCVA was 0.33 Log MAR ± 0.12 and mean CT was 266 µm ± 20.9. Nineteen out of twenty-five eyes (76%) achieved a gain of vision between 1 to 3 lines and gain of 3 lines was achieved in 8% of cases. At the final follow-up there was incomplete resolution of sub retinal fluid in 4 eyes (16%) with no improvement in BCVA.

**Conclusion:** SMT (810 nm) is an effective and minimally invasive treatment modality for chronic CSR.

**Key Words:**

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## INTRODUCTION

Central serous retinopathy (CSR) is a retinal disorder characterized by a localized serous retinal detachment at the macula due to leakage from choriocapillaries through a dysfunctional retinal pigment epithelium (RPE). It is a unilateral condition, usually affecting young and middle-aged adults, with a male predominance.[1,2]

Common risk factors include type A personality, male gender, steroid use, stress, pregnancy, alcoholism, smoking, H. pylori infection and hypermetropia.[3]

Patients present with blurring of vision, metamorphopsia, micropsia and mild dyschromatopsia. Spontaneous resolution occurs in 3-6 months. More than 30% of the patients may have recurrent or chronic serous detachment, which leads to photoreceptors and RPE degeneration causing permanent loss of vision. Duration of chronic CSR is

*Correspondence: Mariam Shamim Kashif*
*Department of Ophthalmology, Layton Rahmatullah Benevolent Trust Eye Hospital, Lahore*
*Email: mariamshamim@hotmail.com*

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varying; in some studies, the duration is 3 months while in others 4 to 6 months.[4,5] In our study we have used duration of ≥ 6 months to define chronic CSR.

Observation with adjustment of modifiable risk factors, like cessation of steroid use and control of systemic hypertension, remains first line of management.[6] Treatment is usually indicated in patients with chronic CSR, patients who require early visual recovery or in patients with loss of vision due to CSR in the fellow eye. Treatment options include photodynamic therapy (PDT), focal laser of the leaking points, sub threshold micro pulse laser and intravitreal anti-vascular endothethial growth factor (anti-VEGF). However, all these treatments are associated with risk and complications.[7] Complications of focal laser include foveal burn, choroidal neovascularization (CNV) and scotoma.[8] PDT with half dose vertiporfin dye is an effective treatment, but it is a relatively invasive and expensive procedure with risk of RPE atrophy, choroidal ischemia, and secondary CNV.[9] Intravitreal Anti VEGF has varying response in the treatment of chronic CSR and can cause complications like increased intraocular pressure, intraocular inflammation and endophthalmitis.[10] Because of above mentioned risks, sub-threshold micropulse laser treatment (SMT) can be a safe and effective alternative.

In SMT the laser impact is divided into many repetitive micropulses. Each micropulse depending on the duty cycle (DC) has an active time of work of laser ("ON" time) and interpulse time ("OFF" time). For instance, for a 5% DC a 200 ms envelope is divided into 100 micro pulses, the micropulse duration ON time will be 0.1 ms.[11] The sub-threshold laser stimulates RPE to improve its function causing resolution of sub retinal fluid (SF). The purpose of our study was to find out the effectiveness of (SMT) for the treatment of chronic CSR.

## METHODS

All procedures were performed at Layton Rahmatulla benevolent trust eye hospital after obtaining approval from the local ethical committee. The study was conducted from April 2019 to July 2020. The inclusion criteria were age ≥ 20 years, visual complaints of ≥ 6 months and presence of sub retinal fluid (SF) on SD-OCT. Patients with history of treatment with other modalities like anti-VEGF, focal laser or PDT, other retinal disorders and associated CNV were excluded from the series. All patients underwent comprehensive ocular examination, baseline BCVA was recorded with Snellen's chart and then converted to log MAR for statistical analysis. Baseline SD OCT and Fundus fluorescein angiography (FFA) were performed in all patients using Spectralis (Heidelberg Engineering). Sub-retinal fluid (SF) and Central retinal thickness (CT) were recorded with automated segmentation program and was used to measure the outcome of the treatment. On FFA focal and diffuse leaking points were identified to use as a guide for laser treatment.

A written and informed consent was taken after explaining the benefits and potential risks of laser treatment. All patients underwent treatment with sub-threshold micropulse (Iris Medical Oculight SLx, 810nm diode) laser. Power was titrated in each patient. First, a 'test' spot of 100 $\mu$m was placed outside the arcade in superotemporal retina. Exposure time was 100ms and the power was enough to cause mild retinal reaction. With the same spot size and exposure time but half the power, 5% DC and in micro pulse mode, confluent laser burns were applied over areas of RPE leak on FFA. There was no retinal burn evident at the end of laser.

Follow up of patients was at four weeks, three months, and six months. The final assessment was done at 6 months and treatment outcome was measured as final BCVA, resolution of sub retinal fluid (SF) and change in CT on OCT. Data was analyzed using The Statistical Package for Social Sciences (IBM SPSS 25).

## RESULTS

Twenty five eyes of 24 patients of Chronic CSR (≥ 6 months' duration) were recruited in the study. Mean age of the patients was 43 ± 6 years. Mean baseline CT was 362.2 μm ± 32.6 with maximum thickness of 450 μm and presenting mean BCVA was 0.46 Log MAR ± 0.12. Laser was applied in all patients only once and the final evaluation was done at 6 months. Mean CT at 6-month follow-up was 266 μm ± 20.9, correlating with a mean decrease of 97.2 μm ± 21.8 from the baseline. The mean BCVA after treatment was 0.33 log MAR ± 0.12, as shown in Table 1. There was a maximum gain of 0.3 log Mar in 8% of eyes. At the final follow-up, there was incomplete resolution of SF in 4 (16%) eyes with no improvement in BCVA, and they were referred for alternate treatment.

**Table 1:** *Treatment Results (Visual acuity is reported in Log Mar).*

| | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|
| Baseline BCVA | 0.30 | 0.80 | 0.46 | 0.128 |
| Baseline CT | 298 | 450 | 363.24 | 32.684 |
| BCVA at 6Months | 0.00 | 0.80 | 0.33 | 0.155 |
| CT at 6Months | 232 | 320 | 266.04 | 20.983 |
| BCVA difference at 6Months | 0.00 | 0.30 | 0.13 | 0.085 |
| CT difference at 6Months | 56 | 144 | 97.20 | 21.897 |

## DISCUSSION

In the micropulse mode, the laser impulse is divided into repetitive short pulses between which there are intermissions that allow the retinal tissue to cool down. This restricts heat conduction to the neighboring tissues, therefore, RPE confined laser is delivered while sparing the neurosensory retina. The idea is to stimulate RPE causing resorption of sub retinal fluid.[12] Temperature rise is below the threshold for coagulation hence micropulse laser does not heal by coagulation and scarring. It produces therapeutic benefit with no detectable sign of iatrogenic damage. The 810 nm sub-threshold diode laser (near infrared spectrum) used in current study allows deeper penetration of tissues, in particular the choroid. This deep penetration is beneficial for central serous retinopathy since diseased choroid plays a role in the pathogenesis of CSR. A likely side effect of the 810-nm laser is pain during laser; however, this is infrequent in the micropulse treatment.[13]

Sub-threshold micropulse laser has also been used for treatment of macular edema caused by different retinal diseases.[14,15,16] Various studies have been conducted using micropulse laser for successful treatment of chronic CSR. Bandello et al presented pilot study exploring SMT for CSR in 2003.[17] They used sub-threshold micro pulse diode laser (810 nm) with 10%-15% DC. Their study reported complete resolution of SRF in 100% of the eyes, and no recurrence during follow-up.

Present study demonstrates use of 810nm at 5% DC SMT for chronic CSR. In this study, we observed the patients for ≥ 6 months, and laser treatment was offered when spontaneous resolution was unlikely. Most of the patients in our study had focal leakage which was demonstrated on FFA prior to laser treatment and laser was applied to the leaking points. We have used improvement in BCVA, changes in CT and resolution of SF on SD-OCT to assess response to laser. Similar parameters were used by Khatri, Anadi et al who studied role of sub-threshold green laser (532nm) in CSR of > 3 months.[18] At final follow-up they reported a mean visual gain of 3.91 ± 0.98 lines and incomplete resolution of sub-retinal fluid in one patient. Our study reported a mean visual gain of 1.32 ± 0.85 lines at final follow-up and an incomplete resolution of SF in four (16%) eyes.

Chen et al, in 2008 also treated patients of CSR of >4 months duration and juxtafoveal leak, using 810nm Diode laser.[19] In their study a gain in vision of ≥ 3 lines was attained in 57% of patients and between 1 to 3 lines in 23% of cases after 6 months. In our study, 19 out of 25 eyes (76%) achieved a gain of vision between 1 to 3 line and of 3 lines in 8% of cases.

Yadav et al studied the effect of 577nm (yellow) sub-threshold laser for chronic CSR treatment.[7] They used average decrease in SF height as a parameter and followed the patients for a mean period of 8 weeks. In their study there was a mean decrease in SF height by 182 μm. Fluid height was not measured in our study, instead we have used a decrease in the CT as a parameter to measure the treatment outcome. There was a mean decrease of 97.2 μm ± 21.8 in CT from the baseline.

One drawback of using sub-threshold laser was the absence of laser marks on retina hence there is a chance of multiple treatments over the same area. Ricci et al overcame this problem by doing an ICGA guided sub-threshold laser directly over the leakage.[20] Our patients did not undergo ICGA before laser, and we feel this was a limitation of our study.

Present study revealed reduction of CT in all cases. Though the BCVA improvement was small, this was comparable with results of Gawęcki, Maciej et al.[21] This may be because of chronicity of CSR which results in permanent damage to the photoreceptor and RPE. Wang et al demonstrated that persistence of SF for more than 4 months could result in foveal atrophy.[22] Luttrull JK reported a substantial improvement in BCVA. They included acute cases in their study, which could be the cause of better visual gain.[23] The reasonable interpretation that can be

obtained from this is the consideration of SMT earlier than 6 months after onset of CSR.

Our study outcomes provide adequate evidence that SMT with 810nm diode laser leads to resolution of SF and a decrease in CT with satisfactory morphological improvement and can be used in the treatment of chronic CSR.

A longer duration and a lager sample size study would be valuable to further evaluate the response to SMT. Furthermore, to prove limited neurosensory retinal damage with sub-threshold laser supplementary investigations for instance, fundus autoflourescence (FAF), multifocal electroretinography and microperimetry may be beneficial.

## CONCLUSION

For chronic CSR, sub-threshold micropulse diode laser (810 nm) treatment is an effective and safe option with good morphological and functional outcomes.

## Ethical Approval

The study was approved by the Institutional review board/Ethical review board.
**(LRBT/TTEH/ERC/2722/21).**

## Conflict of Interest

Authors declared no conflict of interest.

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## Authors' Designation and Contribution

Mariam Shamim Kashif; Associate Ophthalmologist: *Concept, Design, Manuscript preparation, Manuscript editing.*

Najia Uzair; Consultant Ophthalmologist: *Literature search, Manuscript editing.*

Lubna Feroz; Consultant Ophthalmologist: *Data acquisition, Data analysis, Manuscript review.*

Asaad Mehmood; Consultant Ophthalmologist: *Statistical analysis, Manuscript review.*