

Sub-threshold 577-nm Yellow Laser treatment in Central Serous Chorioretinopathy (CSCR): Bridging the Therapeutic Gap in Resource-Constrained Settings

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ABSTRACT

Purpose: To assess the anatomical and functional outcomes of sub-threshold 577-nm yellow laser in patients with Central serous chorioretinopathy (CSCR).

Study Design: Interventional case series.

Place and Duration of Study: POB Eye Hospital, Karachi from February 2025 to July 2025.

Methods: This study involved 35 patients with CSCR clinically diagnosed and confirmed on OCT. The patients were subjected to sub-threshold 577 nm yellow laser in neurosensory detachment areas. The best-corrected visual acuity (BCVA, LogMAR) and central macular thickness (CMT) were assessed at baseline, 1, 3, and 6 months after therapy. Acute (<3 months) and chronic (>3 months) CSCR were analyzed separately.

Results: A total of 35 participants participated in the study, with a mean age of 41.2 ± 6.5 years. There were 80% males. Twenty-three participants (65.7%) had acute CSCR, and 12 (34.3%) had chronic CSCR. The BCVA improved significantly from 0.30 (0.25-0.35) to 0.00 (0.00-0.08) LogMAR ($p < 0.001$) at 6 months, and CMT reduced from $0.426 \pm 87\mu\text{m}$ to $0.259 \pm 64\mu\text{m}$ at 6 months ($p < 0.001$). Acute cases had better anatomical recovery and reduced CMT than chronic cases, but there were no differences between visual gains in acute and chronic cases. No negative effects of lasers were found.

Conclusion: Sub-threshold 577-nm yellow laser therapy is safe and effective in the treatment of acute and chronic CSCR, as it leads to resolution of subretinal fluid and improvement in visual acuity.

Keywords: Central Serous Chorioretinopathy, Laser Therapy, Laser, Lasers, Visual Acuity, Retinal Thickness, Macula Lutea.

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INTRODUCTION

Central serous chorioretinopathy (CSCR) is a chorioretinal condition characterized by serous

detachment of the neurosensory retina in macular area, resulting in blurred vision, metamorphopsia, and relative central scotoma.¹ Choroidal vascular hyperpermeability due to retinal pigment epithelium (RPE) dysfunction is the primary cause of the disease, which leads to the sub retinal fluid accumulation.² Although acute CSCR can resolve on its own in most cases, a significant percentage of patients develop persistent or recurrent disease, which may lead to irreversible photoreceptor damage and permanent visual impairment.^{1,3} CSCR is most common among

young to middle-aged adults with a male predominance.⁴ According to epidemiological studies, the incidence is 5-10 cases per 100,000, and males are diagnosed nearly six times more frequently than females.⁵ Important risk factors are stress, type-A personality, corticosteroid use, pregnancy and hypertension.⁵ Chronic CSCR, which is characterized by sub retinal fluid that persists for more than three months, is a therapeutic challenge because it is associated with advanced retinal and RPE atrophy.⁶ Various treatment modalities have been tried in the management of chronic and recurrent CSCR, such as photodynamic treatment (PDT), mineralocorticoid receptor antagonists, focal laser photocoagulation and micro pulse laser therapy.⁷ Full threshold laser photocoagulation of the leaking point might accelerate fluid dissolution but possible side effects include macular scarring, scotoma and secondary chorioretinal neovascular membrane.^{8,9}

Sub-threshold laser treatment has proved to be a promising alternative, presenting a therapeutic effect but with minimal retinal damage.¹⁰ A subthreshold 577-nm yellow laser has received more attention because of its desirable absorption spectrum, which selectively targets melanin and oxyhemoglobin and is not absorbed by the xanthophyll pigments of the macula.¹¹ At a sub-threshold level, laser energy is less than what is needed to cause visible retinal damage. This stimulates RPE to improve its function, leading to fluid resorption without causing thermal damage to the neurosensory retina.¹²

Although there are advancement in the management of the central serous chorioretinopathy, but an effective and safe treatment that can work on the macular area at all times has never been achieved, especially in patients who have persistent or recurrent disease.¹³ Traditional laser photocoagulation is associated with the threat of irreversible retinal injury, whereas photodynamic therapy, despite its success, is constrained by a high price, decreased accessibility, and possible adverse effects on the choroid and RPE.¹⁴ This highlights why sub-threshold 577-nm yellow laser therapy requires additional consideration to determine its suitability as a safe, cost-effective, and non-dependent of appearance treatment modality in the treatment of CSCR. The goal of this study was to determine anatomical resolution of subretinal fluid and the enhancement of visual acuity after sub-threshold yellow laser 577nm treatment in CSCR patients.

METHODS

This prospective interventional study was conducted at the POB Eye Hospital, Karachi over a period of six months, from February 2025 to July 2025. Ethical approval was obtained from the Institutional Review Board (**ERB-POB-008/2025 Date: January 6 2025**). The sample size was calculated using Open Epi software, Version 3, with a 95% confidence level, a margin of error of 10%, and an estimated treatment success rate of 66.7% for sub-threshold '577-nm micro pulse laser therapy in CSCR, based on previously published data.¹⁵ The sample size was 35 participants who were recruited using non-probability consecutive sampling. Patients who had a clinical diagnosis of acute or chronic central serous chorioretinopathy, and who met the eligibility criteria were included until the required sample size was achieved. The study included patients of 18 years and above with CSCR diagnosed clinically and with optical coherence tomography OCT. Patients with other macular pathologies, previous laser or photodynamic treatment of CSCR and media opacities were excluded.

All participants were evaluated for demographic data and thoroughly assessed ophthalmologically. The best-corrected visual acuity (BCVA) was assessed using the LogMAR scale, and central macular thickness(CMT) and subretinal fluid were measured using spectral-domain OCT.

All patients signed informed consent before their enrolment after being informed about the nature of the study, its purpose, and possible risks. The patients were treated using sub-threshold (577-nm) yellow laser over the whole region of neurosensory detachment detected on OCT.

The laser parameters were spot size of 150-200 micrometers and a burn spacing of 0.25, using an area centralis lens. Test burns were performed outside the macular area at full threshold settings until a barely visible burn was observed. Subsequently, the laser power was reduced to 50% of the threshold to achieve sub-threshold treatment. A range of 150-200 spots were applied on the affected region. Follow-up evaluations were conducted at one, three, and six months, during which BCVA and OCT were performed at each visit to assess functional and anatomical outcomes, including CMT and the resolution of subretinal fluid. Adverse effects of the laser were closely monitored throughout the study period.

Table 1: Functional and Anatomical Outcomes Pre- and Post-Treatment.

Parameter	Baseline	1 Month	3 Months	6 Months	p-value (Baseline vs 6M)
BCVA (LogMAR)	0.30(0.25–0.35)	0.20(0.15–0.30)	0.20(0.10–0.30)	0.00(0.00–0.08)	< 0.001
CMT (μm)	426 $\pm$ 87	383 $\pm$ 84	336 $\pm$ 81	259 $\pm$ 64	< 0.001

Table 2: Outcomes Stratified by CSCR Chronicity (Acute vs Chronic) (n=35).

Parameter	Acute CSCR(n = 23)	Chronic CSCR(n = 12)	p-value
Baseline BCVA (LogMAR)	0.28 (0.22–0.35)	0.37 (0.30–0.45)	< 0.001
BCVA at 6 months (LogMAR)	0.05 (0.00–0.10)	0.11 (0.05–0.15)	0.48
Baseline CMT (μm)	398 $\pm$ 72	466 $\pm$ 92	< 0.001
CMT at 6 months (μm)	236 $\pm$ 53	293 $\pm$ 71	< 0.001

Data was entered and analyzed using Statistical Package for the Social Sciences (SPSS), version 25. The Shapiro-Wilk test was used to determine the normality of continuous data including age, BCVA (LogMAR), and CMT. Data with normal distribution was presented as mean $\pm$ standard deviation, while non-normal distribution was reported as median and interquartile range. Categorical variables were presented in frequency and percentages.

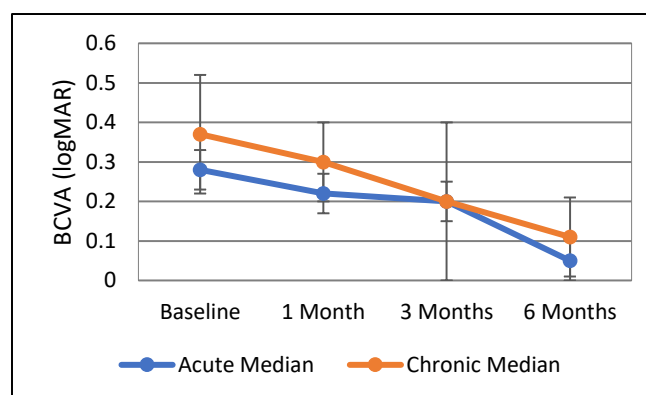
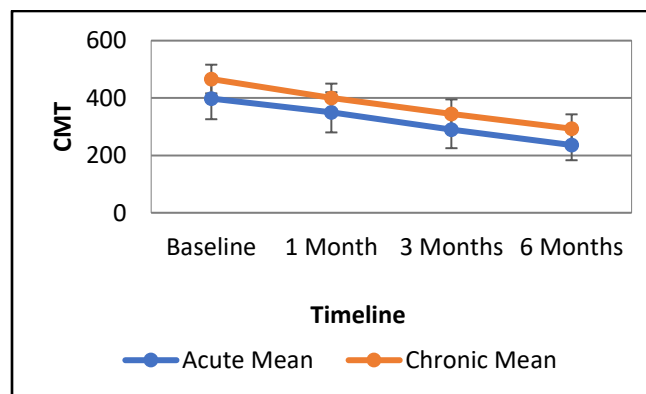
BCVA and CMT were compared before and after treatment at 1, 3, and 6 months using paired-sample t-tests in normally distributed data and the Wilcoxon signed-rank test in non-normally distributed data. All follow-up visits were compared using repeated measures analysis to see how visual acuity and central macular thickness changed over time. Patients were divided into acute and chronic groups based on their CSCR history to investigate the influence of disease chronicity. The groups' anatomical and functional data were compared using independent-sample t-tests and the Mann-Whitney U test. A p-value < 0.05 indicated statistical significance.

RESULTS

A total of 35 participants were included, with a mean age of 41.2 ± 6.5 years. There were 80% males and 23 patients (65.7%) had acute CSCR and 12 (34.3%) had chronic CSCR. BCVA was significantly better at 6 months than at baseline ($p < 0.001$), whereas the CMT was significantly lower ($p < 0.001$) at 6 months than at baseline (Table 1).

Figure 1 represents the visual and anatomical changes over time after subthreshold laser treatment stratified by CSCR chronicity. BCVA improved gradually, although more quickly in acute cases than in

chronic ones. At 6 months, the two groups had similar visual gains. Mean CMT similarly improved over time in acute and chronic cases with acute CSCR showing a larger gain at subsequent follow-up. These trends demonstrate that treatment is effective in both acute and chronic patients, but anatomical recovery is more evident in acute cases.

**Figure 1:** Median BCVA Over Time after Subthreshold 577nm Laser (Acute vs Chronic).**Figure 2:** Mean CMT Over Time after Subthreshold 577nm Laser (Acute vs Chronic).

DISCUSSION

Functional and anatomical results were significantly improved in 35 CSCR patients receiving subthreshold 577 nm laser, with CMT decreasing and BCVA improving significantly over 6 months. The Sub-threshold 577-nm yellow laser therapy provides a better option because it specifically attacks the RPE, sparing the neurosensory retina and thus facilitating the resolution of subretinal fluid without causing visible retinal scarring.

These findings are consistent with several global studies, which confirm the effectiveness of subthreshold laser modalities in CSCR. In acute CSCR, 577 nm subthreshold micro pulse laser (SML) has been demonstrated to produce significantly greater BCVA and CMT reduction than controls (significant at $P < 0.01$) over 6 months and demonstrates the advantage of prompt disease intervention by laser (significant at $P < 0.01$).¹⁵ Moreover, in an acute CSCR randomized controlled trial comparing 577 nm SML and conventional laser revealed that the two modalities had similar visual and anatomical outcomes after 6 months of treatment ($P < 0.001$), with an added benefit of less retinal damage in the SML cohort (RPE damage significantly lower, $P < 0.001$).¹⁶ The results are in line with our observation that vision improved in both the acute and chronic groups, and were similar after 6 months ($P = 0.48$), even though they were dissimilar at baseline, indicating that subthreshold laser is effective in various CSCR presentations.

Anatomical improvements have also been reported in a study of chronic CSCR.¹⁷ A retrospective cohort study also found a substantial reduction in CMT ($p < 0.001$) and moderate improvement in vision after SML treatment ($P = 0.039$), which aids in validating the role of 577 nm lasers, even in cases with persistent subretinal fluid that did not respond to other treatments.¹⁷ Another study of chronic CSCR showed that at 2 months, both BCVA and CMT ($P < 0.001$) had significant improved at a comparatively young age.¹⁸ These results resonate with our results of much lower CMT on acute and chronic CSCR at 6 months ($P < 0.001$) and lend strength to the notion that acute disease can better respond to subthreshold laser therapy.

Subthreshold laser efficacy in reducing CMT and achieving anatomical resolution is also supported by meta-analytic evidence, although pooled analyses have found inconsistent effects of sub foveal choroidal

thickness in comparison to other control treatments ($P < 0.05$ in some studies).¹⁹ This highlights the importance of customized treatment planning and additional prospective data on large scale.

Regional literature similarly suggests that subthreshold and other low-energy laser modalities provide favorable outcomes in CSCR, with minimal complications, consistent with international evidence supporting their safety and efficacy.²⁰ Studies evaluating other subthreshold laser wavelengths, including 532 nm, have reported significant reductions in CMT and improvements in visual acuity ($P < 0.05$), accompanied by low complication rates among patients with chronic CSCR. These findings further support the clinical applicability and safety of subthreshold laser strategies in the management of CSCR.²⁰

Although this study contributes to the knowledge regarding the efficacy of subthreshold 577 nm laser in CSCR, the research has several limitations. Small sample size and single center study restricts its generalization, and the follow-up was limited to six months, which did not allow for evaluating the long-term recurrence rates or sustained functional outcomes. Since it was a single arm study, relative results of other treatment modalities could not be evaluated. These findings should be verified by multicenter studies using larger cohorts and longer follow-up.

CONCLUSION

Sub-threshold 577 nm laser therapy is a safe and effective treatment for CSCR. This therapy can lead to significant improvements in both visual acuity and anatomical recovery. While acute cases typically show more pronounced anatomical resolution, both acute and chronic patients experience considerable functional benefits from the treatment. These findings align with the increasing use of subthreshold laser as a primary or supplemental treatment for CSCR management, offering a valuable and minimally invasive option with limited risk of retinal damage.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board (POB-ERB-008/2025)

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