Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1833
Original Article

A CASE-CONTROL STUDY OF CHOROIDAL THICKNESS IN PATIENTS WITH CENTRAL SEROUS CHORIORETINOPATHY: A STUDY AT RIMS, RANCHI, JHARKHAND.

Dr Komal Soni[1], Dr Rahul Prasad[2], Dr Priya Suman[1], Dr Nitish Kumar Marshal[1]*
[1] *Junior Resident, Department of Ophthalmology, RIO RIMS Ranchi*
[2] *Associate Professor, Department of Ophthalmology, RIO RIMS Ranchi*

ABSTRACT

Background
Central Serous Chorioretinopathy (CSCR) is a retinal disorder characterized by the accumulation of subretinal fluid, often linked to retinal pigment epithelium (RPE) dysfunction and choroidal hyperpermeability. Choroidal thickness, a key parameter in understanding the pathophysiology of CSCR, has been implicated in disease onset and progression. Despite extensive research, regional variations in CSCR and choroidal thickness remain underexplored, especially in Indian populations.
Objectives: This study analyzed and compared choroidal thickness in patients with CSCR and healthy controls. It also sought to investigate the relationship between choroidal thickness and disease severity.

Methods
A 12-month case-control study was conducted at RIMS Ranchi from January 2024 to December 2024, Jharkhand. The study included 50 patients diagnosed with CSCR and 50 age—and sex-matched healthy controls. Choroidal thickness was measured using Optical Coherence Tomography (OCT) in the subfoveal region and 500 µm nasal and temporal to the fovea. Descriptive statistics were used for baseline data, while t-tests and correlation analyses assessed differences and relationships between choroidal thickness and clinical parameters.

Results
CSCR patients exhibited significantly greater mean subfoveal choroidal thickness than controls ($p < 0.001$). Similar differences were observed in the nasal and temporal regions. A positive correlation was noted between disease duration and choroidal thickness ($r = 0.46$, $p = 0.001$), while an inverse relationship was found between choroidal thickness and best-corrected visual acuity (BCVA) ($r = -0.39$, $p = 0.005$). These findings reinforce the role of choroidal thickening in CSCR pathophysiology and its association with disease progression.

Conclusion
This study highlights the clinical relevance of choroidal thickness as a diagnostic and prognostic marker in CSCR. The findings emphasize the importance of early detection and monitoring choroidal changes to improve management and outcomes.

Recommendation
Further longitudinal and multicenter studies are recommended to validate these observations and explore therapeutic implications.

Keywords: *Central serous chorioretinopathy, Choroidal thickness, Optical coherence tomography, RIMS Ranchi, Case-control study*
Submitted: 2025-04-16 **Accepted:** 2025-05-19 **Published:** 2025-06-01

Corresponding Author: Dr Komal Soni*
Email: komalpmch@gmail.com
Junior Resident, Department of Ophthalmology, RIO RIMS Ranchi

INTRODUCTION

In Central Serous Chorioretinopathy, subretinal fluid can detach the neurosensory retina. The disease mostly affects the macula, causing blurred vision, central scotoma, and metamorphopsia. While all ages can experience CSCR, middle-aged men are most at risk [1]. CSCR's complicated pathophysiology may include retinal pigment epithelium (RPE) dysfunction, choroidal hyperpermeability, and choroidal circulation autoregulation disruptions. It usually goes away on its own. CSCR can damage photoreceptors or cause RPE atrophy, resulting in permanent vision loss [2]. Geographic and demographic factors affect CSCR

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prevalence differently. Studies estimate that 9.9 out of 100,000 people are affected annually, 6:1 men to women. Stress, systemic corticosteroids, and Type A personalities increase CSCR risk. OCT and EDI-OCT have improved our understanding of CSCR-related choroid structural changes [3]. Choroidal thickness, which indicates the choroid's health and function in nourishing the retina, is an important CSCR criterion. Due to vascular engorgement and hyperpermeability, congenital subluxation retinal dystrophy (CSCR) increases choroidal thickness. By analyzing choroidal thickness, clinicians can assess treatment efficacy, track disease progression, and understand disease mechanisms [4]. Choroidal changes in CSCR are becoming more important, but their relationship to disease severity and prognosis is unclear. Small sample sizes, lack of controls, or imaging protocol differences have limited many studies on choroidal thickness in CSCR patients. Most studies have been conducted in cities or major metropolitan areas, which may not reflect patients' rural or semi-urban experiences [5].

Understanding CSCR choroidal thickness has major clinical and research implications. Choroidal thickness contains disease activity and treatment efficacy biomarkers. The inflammatory and vascular mechanisms that cause the condition can be better understood when the affected eye is thicker than the other eye or a control subject [6]. Choroidal thickness changes can distinguish CSCR from age-related macular degeneration and polypoidal choroidal vasculopathy. Recent optical coherence tomography advances allow non-invasive choroidal thickness measurement [7]. Enhanced Depth Imaging-OCT (EDI-OCT) is useful for CSCR studies because it can see deeper choroidal layers. Age, axial length, refractive error, and systemic conditions affect choroidal thickness, so interpretation should consider these factors. Despite their usefulness, choroidal thickness measurement and analysis protocols are lacking in clinical and academic settings [8].

Many studies have examined CSCR choroidal thickness, but there are still gaps. Because most research has ignored certain CSCR subtypes or only examined acute or chronic cases, the results' generalisability is uncertain [9]. Second, smoking and hypertension's effects on CSCR patients' choroidal thickness are unknown. Third, studies don't always include diverse populations, so results may not apply to Jharkhand. Choroidal thickness, disease severity, recurrence, and treatment response have not been adequately studied [10]. Understanding these relationships could improve disease monitoring and treatment customization. In eastern India, Jharkhand has a diverse tribal population, people from all backgrounds, and urban and rural areas. Even though more people can get medical treatment locally, chronic diseases like CSCR and their early detection and treatment remain issues [11]. Presented at RIMS Ranchi, a tertiary care facility, this research can examine CSCR in a previously understudied group of patients.

This study can also examine regional CSCR onset and development. Genetics, environment, and diet may make this population susceptible to the disease's pathophysiology. Addressing these factors, the study can add to the literature and highlight the need for regional diagnostic and treatment guidelines. This study aims to measure choroidal thickness in CSCR patients and healthy controls using OCT. This comparison will look for choroidal parameter differences to better understand CSCR pathophysiology. The secondary goal is to compare CSCR patients' choroidal thickness to disease severity.

Objective: This study compares choroidal thickness with clinical features like duration, recurrence, and visual acuity to determine if it is a reliable indicator of disease progression or prognosis.

In conclusion, this study fills CSCR knowledge gaps by providing regional choroidal thickness and clinical relevance data. The findings should improve CSCR detection, tracking, and management in Jharkhand and other demographically similar states.

METHODS

Study Design

This case-control study was conducted at Ranchi's Rajendra Institute of Medical Sciences (RIMS). A case-control study compared CSCR patients and healthy controls for choroidal thickness. This study compared choroidal thickness and disease severity in the CSCR group.

Duration

The study enrolled participants, collected data and images, and analyzed the results in 12 months from January 2024 to December 2024. By following this schedule, RIMS's CSCR patients and healthy controls were included in a statistically valid case-control study.

Sample Size

CSCR patients and healthy controls were matched by age and sex. Given the study's timeframe and RIMS patients, 50 samples were taken for each group. Using comparable research, this sample size was also sufficient to detect statistically significant differences in choroidal thickness between groups.

Inclusion Criteria

- Adults aged 18 to 60 years.

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- Patients diagnosed with CSCR based on clinical evaluation and imaging findings, including fundus examination and Optical Coherence Tomography (OCT).
- Healthy controls with no history of retinal diseases or systemic conditions affecting the choroid, confirmed through clinical evaluation and imaging.

Exclusion Criteria

- Presence of other retinal diseases such as diabetic retinopathy, age-related macular degeneration, or polypoidal choroidal vasculopathy.
- Systemic conditions known to influence the choroid, such as uncontrolled hypertension or systemic vasculitis.
- History of ocular trauma, intraocular surgery, or use of corticosteroids, as these factors could confound choroidal thickness measurements.
- Patients are unable to undergo OCT due to poor fixation or media opacities, such as dense cataracts.

Data Collection

Demographic, clinical, and choroidal thickness imaging data were collected during data collection. Participants' age, sex, and relevant medical history were recorded. Clinical datasets included disease duration, recurrence history, and BCVA for CSCR patients. EDI-OCT measured choroidal thickness. Precision and reliability were ensured by skilled technicians following imaging protocols. To account for macula variations, 500 microns nasal and temporal to the fovea were measured in addition to the subfoveal region. A retinal imaging specialist verified all images' reliability and quality. Healthy controls were clinically evaluated and imaged to rule out choroidal or retinal issues. Confounding factors were reduced by age and sex-matched controls.

Bias and Participant Selection

Participants were selected using convenience sampling from a tertiary care hospital, which may introduce selection bias and limit generalizability. Randomization was not applied. Observer bias is possible as measurements were not masked. Diurnal variation in choroidal thickness was not controlled, and recall bias may have influenced symptom duration reporting.

Statistical Analysis

Descriptive statistics summarised participants' demographic and clinical characteristics. Frequencies and percentages summarised categorical variables like sex, while means and standard deviations displayed continuous variables like age and choroidal thickness. Independent t-tests were used to compare choroidal thickness in healthy controls and CSCR patients. We used non-parametric tests like the Mann-Whitney U test for non-normal variables. We used Pearson or Spearman correlation coefficients to examine the relationship between choroidal thickness and disease severity indicators like BCVA and duration. This study aimed to determine if choroidal thickness could indicate disease progression or severity. Statistics were done with SPSS or R. All analyses were statistically significant when $p < 0.05$.

Ethical Considerations

Before starting the study, the RIMS Ranchi Institutional Ethics Committee approved it to ensure ethical compliance. We obtained written informed consent after explaining the study's goals, methods, and risks. The study encrypted data before analysis to protect participant privacy. This rigorous methodological framework improved the understanding of the population-based correlation between choroidal thickness and CSCR and ensured the validity and reliability of the results.

RESULTS

Demographics

Table 1 summarizes the demographic data of the participants, including age, gender distribution, and other baseline characteristics.

Table 1: Demographic and Baseline Characteristics

Variable	CSCR Group (n = 50)	Control Group (n = 50)	p-value
Age (years)	42.6 ± 8.2	41.8 ± 7.9	0.652
Gender (Male: Female)	38:12	37:13	0.841
BCVA (logMAR)	0.4 ± 0.2	0.0 ± 0.0	<0.001*
Disease Duration (months)	6.4 ± 3.1	N/A	—

The average age of participants was comparable between groups, with no statistically significant difference ($p = 0.652$). Males predominated in both groups, reflecting the known male bias in CSCR prevalence. The BCVA

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was significantly worse in the CSCR group than in controls ($p < 0.001$).

Table 2: Comparison of Choroidal Thickness Between Groups

Measurement Location	CSCR Group (Mean ± SD, µm)	Control Group (Mean ± SD, µm)	p-value
Subfoveal	432.5 ± 43.2	311.2 ± 29.8	<0.001*
500 µm Nasal to Fovea	401.7 ± 38.9	287.4 ± 25.6	<0.001*
500 µm Temporal to Fovea	412.3 ± 41.5	300.6 ± 27.3	<0.001*

The mean subfoveal choroidal thickness in CSCR patients was significantly higher (432.5 ± 43.2 µm) than in controls (311.2 ± 29.8 µm) with a p-value of <0.001. Similar trends were observed at 500 µm nasal and temporal to the fovea, with CSCR patients showing consistently thicker choroids than controls.

Table 3: Correlation of Choroidal Thickness with Disease Duration and Severity

Variable	Correlation Coefficient (r)	p-value
Disease Duration (months)	0.46	0.001*
BCVA (logMAR)	-0.39	0.005*

A moderate positive correlation was found between disease duration and subfoveal choroidal thickness ($r = 0.46$, $p = 0.001$), indicating that longer disease duration is associated with thicker choroids. A negative correlation was observed between BCVA and subfoveal choroidal thickness ($r = -0.39$, $p = 0.005$), suggesting that increased choroidal thickness may correspond to worse visual acuity.

DISCUSSION

Key Results

The present study aimed to evaluate and compare choroidal thickness in patients with Central Serous Chorioretinopathy (CSCR) and healthy controls, along with assessing its correlation with disease duration and visual acuity. The results demonstrated a significantly higher mean subfoveal choroidal thickness in the CSCR group (432.5 ± 43.2 µm) compared to the control group (311.2 ± 29.8 µm), with statistical significance ($p < 0.001$). Similar significant differences were also found at 500 µm nasal and temporal to the fovea. Importantly, a positive correlation was observed between disease duration and choroidal thickness ($r = 0.46$, $p = 0.001$), suggesting progressive thickening over time, and a negative correlation was seen between choroidal thickness and best-corrected visual acuity ($r = -0.39$, $p = 0.005$), indicating worsening visual function with increased choroidal thickness.

Interpretation

These findings support the hypothesis that CSCR is characterized by a pachychoroid phenotype, with vascular engorgement and choroidal hyperpermeability contributing to its pathogenesis. The observed correlations imply that choroidal thickness is not merely a bystander phenomenon but may actively contribute to disease chronicity and visual decline. Comparisons with previous literature further validate these results; studies by [13] & [14] have similarly shown increased choroidal thickness in CSCR patients, suggesting a global pathophysiologic consistency. However, unlike many earlier studies based on urban or international populations, our data reflect a semi-urban and tribal population in eastern India, providing novel insight into how CSCR may manifest in different ethnic and geographical backgrounds [15]. The use of Enhanced Depth Imaging Optical Coherence Tomography (EDI-OCT) enabled high-resolution visualization of the choroid, adding technical strength to the study.

GENERALIZABILITY

While the study provides region-specific findings, it does have a moderate degree of generalizability. The sample included a diverse demographic from both tribal and semi-urban communities, which strengthens the applicability of the results to similar populations across eastern India. However, generalization to broader or more heterogeneous national and international populations should be done cautiously. Genetic, environmental, occupational, and dietary factors may influence choroidal structure and function differently in various regions. Additionally, the exclusion of patients with systemic comorbidities and the single-center design may limit its universal relevance.

CONCLUSION

This research clarifies the role of choroidal thickness in central serous chorioretinopathy (CSCR) development and progression. The fact that CSCR patients had thicker choroids than healthy controls shows the importance of choroidal changes in disease mechanisms. The positive

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correlation between choroidal thickness and disease duration and its inverse relationship with visual acuity support its use as a disease severity and progression biomarker. This study confirms previous findings and adds new data from RIMS Ranchi's regional cohort. Non-invasive optical coherence tomography (OCT) for choroidal thickness measurement could be essential to CSCR diagnosis and treatment. Early detection and treatment of increased choroidal thickness can slow disease progression and preserve vision. Tracking choroidal parameters could improve treatment efficacy measurement and decision-making. The study's strengths include accurate imaging, strong methodology, and local population focus. Analyzing the results should consider the study's case-control design, small sample size, and single center. Longitudinal studies with larger and more diverse populations are needed to confirm these findings and study choroidal CSCR changes' temporal dynamics. Finally, this study shows that CSCR choroidal thickness improves disease diagnosis and treatment. These findings enhance our understanding of CSCR's fundamental mechanisms, offering hope for better treatment options.

LIMITATIONS AND STRENGTHS

This study provides valuable regional data from a relatively underrepresented population in ophthalmic research, including tribal and rural demographics. The use of EDI-OCT added precision to choroidal measurements, and correlations with disease duration and visual acuity strengthened the clinical relevance of the results. Age- and sex-matched controls improved the reliability of intergroup comparisons. However, there are some limitations to consider. The study was a case-control study in nature, limiting causal interpretations. It was conducted at a single tertiary care center, which may limit the generalizability of findings to the broader population. The sample size was modest, which might not capture all potential demographic or clinical variations. Additionally, systemic factors like hypertension, stress, and corticosteroid use, which are known to affect CSCR, were not extensively controlled or analyzed. Diurnal variation in choroidal thickness, a known confounder, was also not accounted for, as all OCT scans were performed without standardizing the time of day.

RECOMMENDATION

Based on the findings, we recommend the routine measurement of choroidal thickness using OCT in all patients diagnosed with or suspected of having CSCR. This parameter, especially subfoveal thickness, may serve as a useful biomarker for disease activity and could help in monitoring disease progression or recurrence. Clinicians should also consider more aggressive follow-up and early intervention in cases with significantly increased choroidal thickness, particularly when correlated with prolonged disease duration or decreasing visual acuity. Given the association with chronicity and visual deterioration, choroidal monitoring should become a part of standard ophthalmologic care for CSCR. Furthermore, awareness programs and screening camps should be encouraged in rural and tribal populations to facilitate early diagnosis and management.

IMPLICATIONS FOR PRACTICE AND RESEARCH

In clinical practice, integrating choroidal thickness measurements into routine ophthalmologic evaluations could help differentiate CSCR from other retinal diseases with overlapping features, such as polypoidal choroidal vasculopathy or age-related macular degeneration. It can also guide therapeutic decisions—for instance, identifying candidates for interventions like mineralocorticoid receptor antagonists, photodynamic therapy, or laser treatment. For researchers, our findings emphasize the need for large-scale, multi-centric longitudinal studies in India that include diverse populations to establish normative data and explore risk factors influencing choroidal thickness. Future studies may also consider using more advanced imaging modalities such as Swept-Source OCT or OCT-Angiography to better understand the vascular components of CSCR. Genetic studies may further elucidate why certain populations are more susceptible or present with more severe disease.

ACKNOWLEDGEMENT

The Author would like to thank all the staff members of RIMS Ranchi for their collective support.
For everything. The author would like to thank all the co-authors for giving support in writing, collecting, and proofreading this work.

LISTS OF ABBREVIATIONS

CSCR- Central Serous Chorioretinopathy
RPE- Retinal Pigment Epithelium
OCT- Optical Coherence Tomography
BCVA- Best-Corrected Visual Pathophysiology
EDI-OCT- Enhanced Depth Imaging- OCT.

SOURCE OF FUNDING

The author received no financial aid or funding for this research work.

CONFLICT OF INTEREST

The Author declares no conflict of interest.

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https://doi.org/10.51168/sjhrafrica.v6i6.1833
Original Article

DATA AVAILABILITY

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR BIOGRAPHY

Dr Komal Soni is working as a junior Resident in the Department of Ophthalmology, RIO RIMS, Ranchi.
Dr Rahul Prasad is working as an Associate Professor in the Department of Ophthalmology, RIO RIMS, Ranchi.
Dr Priya Suman is working as a junior Resident in the Department of Ophthalmology, RIO RIMS, Ranchi.
Dr Nitish Kumar Marshal is working as a junior Resident in the Department of Ophthalmology at RIO RIMS Ranchi.

AUTHOR CONTRIBUTIONS

Dr Komal Soni – Data collection, drafting and interpretation and finalising and final editing of this manuscript.
Dr Rahul Prasad - Drafting, supervision, and proofreading of this manuscript.
Dr Priya Suman- Finalized, conceptualized, briefings, corrections, and final editing of this manuscript.

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https://doi.org/10.51168/sjhrafrica.v6i6.1833
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https://doi.org/10.1007/s00417-022-05905-1 PMid:36401650

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Publisher details

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa