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Original Research Article

EVALUATION OF MORPHOLOGICAL CHANGES IN PATIENTS WITH CENTRAL SEROUS CHORIORETINOPATHY USING OPTICAL COHERENCE TOMOGRAPHY

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ABSTRACT

Background: Central serous chorioretinopathy (CSR) involves idiopathic detachment of the neurosensory retina, primarily affecting the macular region. Spectral-domain optical coherence tomography (SD-OCT) enables detailed visualization of retinal morphology. This study assessed OCT-based morphological changes in CSR patients.

Materials and Methods: A prospective cross-sectional study was conducted on 32 clinically diagnosed CSR patients attending an Ophthalmology outpatient department. Diagnosis was confirmed by SD-OCT. All participants underwent comprehensive ophthalmic evaluation and imaging. Data were analyzed using descriptive statistics, chi-square tests, t-tests, correlation, and regression analysis, with significance at $p<0.05$.

Results: The prevalence of CSR among outpatients was 1.5%. The highest incidence occurred in individuals aged 40–49 years (37.5%), with a mean age of 45.3 ± 8.7 years. Males were more frequently affected (75%), with a 3:1 male-to-female ratio. Most patients (43.8%) reported symptoms for 1–3 months, and 12.5% had chronic disease (>6 months). Blurred vision was the predominant symptom (87.5%), and unilateral involvement was common (71.9%). SD-OCT revealed serous neurosensory detachment (93.8%), subretinal fluid (81.3%), choroidal thickening (>300 µm) (84.4%), and pigment epithelial detachment (68.8%). Acute CSR showed significantly greater central retinal thickness, subretinal fluid height, and macular volume than chronic cases ($p<0.05$). Regression analysis identified retinal sensitivity ($\beta = -0.52$, $p<0.001$) as the strongest predictor of best-corrected visual acuity (BCVA) impairment, followed by macular volume and subretinal fluid height.

Conclusion: CSR predominantly affects middle-aged males and presents with characteristic OCT findings. SD-OCT is a valuable tool for early detection and evaluation of morphological changes, with retinal sensitivity and macular integrity serving as key indicators of visual prognosis.

Keywords: Central Serous Chorioretinopathy; Optical Coherence Tomography; Subretinal Fluid; Choroid; Retinal Pigment Epithelium; Visual Acuity.

INTRODUCTION

Central serous chorioretinopathy (CSC) is characterized by idiopathic detachment of the neurosensory retina in the macular region, resulting from one or more leakage sites in the retinal pigment epithelium (RPE) detected by fluorescein angiography (FA)1. Earlier, RPE dysfunction was thought to be the main cause; however, indocyanine

green angiography (ICGA) has demonstrated multiple areas of choroidal vascular hyperpermeability in CSC patients.[1,2] These areas often correspond with FA leakage sites, though some hyperpermeable regions appear without active fluorescein leakage and can even be present in the asymptomatic fellow eye. This suggests that choroidal vascular changes precede RPE disruption, leading to subretinal fluid accumulation and subsequent neurosensory retinal detachment.[1,2]

Optical coherence tomography (OCT) provides noninvasive, high-resolution cross-sectional retinal imaging. Earlier OCT studies in CSC reported neurosensory detachment, pigment epithelial detachment (PED), subretinal fibrin, and cystic retinal changes. The advent of spectral-domain OCT (SD-OCT) has further improved imaging speed and resolution, allowing detailed visualization of photoreceptor and RPE layers.[3,4] The Spectralis HRA+OCT system combines OCT with confocal scanning laser ophthalmoscopy (cSLO), enabling accurate retinal topography. This study aims to evaluate and compare the SD-OCT imaging characteristics of acute and chronic CSC to better understand the morphological features and disease mechanisms.[3,4]

The present study aims to evaluate the morphological changes in patients with central serous retinopathy (CSR) using optical coherence tomography. It focuses on describing the clinical presentation and characteristic OCT features observed in CSR patients and determining the prevalence of CSR among individuals attending the ophthalmology outpatient department.

MATERIALS AND METHODS

This prospective cross-sectional study was conducted in the Department of Ophthalmology at Karnataka Institute of Medical Sciences (KIMS), Hubballi. The study included adult patients diagnosed with central serous chorioretinopathy (CSR) who attended the Ophthalmology outpatient department during the study period. Diagnosis was based on clinical findings, slit-lamp examination, OCT imaging, and fluorescein angiography (FA) features showing focal or diffuse RPE leakage. A total of 32 clinically confirmed CSR patients were enrolled using a simple random sampling method. The sample size was calculated considering a prevalence rate of 1.7%.

Inclusion criteria comprised adults with newly diagnosed or follow-up CSR cases confirmed by OCT. Patients with ocular infections, inflammatory diseases, advanced diabetic retinopathy, collagen vascular disorders, or unwilling to participate were excluded.

All participants underwent a detailed ophthalmic evaluation, including visual acuity testing (Snellen's and Jaeger's charts), refraction assessment, slit-lamp biomicroscopy, fundus photography, and spectral-domain OCT (SD-OCT) for retinal morphology assessment. Demographic data such as age, sex, and best-corrected visual acuity (BCVA) were documented.

Data were analyzed using SPSS version 25. Descriptive statistics, chi-square tests, t-tests, correlation, and regression analyses were applied, with $p<0.05$ considered significant. Ethical clearance was obtained, and informed consent was taken from all participants, ensuring confidentiality and voluntary participation.

RESULTS

A total of 32 clinically confirmed patients with Central Serous Chorioretinopathy (CSR) were analyzed to evaluate the morphological changes using Spectral-Domain Optical Coherence Tomography (SD-OCT).

The prevalence of CSR among patients attending the ophthalmology outpatient department (OPD) was 1.5%. The mean age of the study participants was 45.3 ± 8.7 years (range: 30–62 years). The highest prevalence was noted in the 40–49 years age group (37.5%), followed by 28.1% in the 50–59 years group, and 15.6% in those aged ≥60 years. A significant male predominance was observed, with 75.0% (n=24) males and 25.0% (n=8) females, indicating a 3:1 male-to-female ratio.

Most patients presented within the early course of the disease. The majority (43.8%) reported symptoms lasting 1–3 months, while 12.5% had chronic symptoms lasting >6 months. The mean duration of symptoms was 2.4 ± 1.1 months.

The most common symptom was blurring of vision (87.5%), followed by metamorphopsia (59.4%), scotoma (50.0%), and micropsia (37.5%). A hypermetropic shift in refraction was noted in 31.3% of cases. Unilateral involvement was more common (71.9%) than bilateral (28.1%).

SD-OCT imaging revealed several characteristic features of CSR (Table 1). The most prevalent finding was serous neurosensory detachment, seen in 93.8% of eyes. Choroidal thickening (>300 µm) was observed in 84.4%, and subretinal fluid accumulation in 81.3% of cases. Pigment epithelial detachment (PED) was identified in 68.8%, IS/OS junction disruption in 43.8%, and hyperreflective dots in 37.5%.

Table 1: Frequency of OCT Findings in CSR Patients (n=32)

OCT Feature	No. of Cases (n)	Percentage (%)
Serous neurosensory detachment	30	93.8%
Choroidal thickening (>300 µm)	27	84.4%
Subretinal fluid accumulation	26	81.3%
Pigment epithelial detachment (PED)	22	68.8%

IS/OS junction disruption	14	43.8%
Hyperreflective dots	12	37.5%

Among the 32 patients, 22 were categorized as acute CSR and 10 as chronic CSR based on symptom duration and OCT features. Acute CSR showed significantly greater central retinal thickness (CRT), subretinal fluid height (SRF), and macular volume (MV) compared to chronic cases ($p<0.05$). Visual function was also better preserved in acute cases. [Table 2]

Table 2: Comparison of OCT Parameters Between Acute and Chronic CSR

Parameter	Acute CSR (n=22)	Chronic CSR (n=10)	p-value
Central Retinal Thickness (µm)	480.2 ± 110.3	420.1 ± 90.4	0.045*
Subretinal Fluid Height (µm)	250.4 ± 98.7	160.3 ± 75.2	0.011**
Macular Volume (mm^3)	3.30 ± 0.60	2.85 ± 0.50	0.034*
BCVA (logMAR)	0.15 ± 0.08	0.25 ± 0.12	0.021*
Retinal Sensitivity (dB)	12.1 ± 3.8	7.8 ± 2.9	0.002**

Significant ($p<0.05$); Highly significant ($p<0.01$)

A correlation analysis was performed to evaluate the relationship between morphological OCT parameters and functional measures such as best-corrected visual acuity (BCVA), contrast sensitivity, and retinal sensitivity (MP-A).

Retinal sensitivity demonstrated the strongest negative correlation with BCVA ($r = –0.52$, $p < 0.001$), indicating that lower retinal sensitivity was associated with poorer visual outcomes. Macular volume ($r = 0.40$, $p = 0.005$) and subretinal fluid height ($r = 0.34$, $p = 0.02$) were also significantly correlated with BCVA, suggesting that greater retinal thickening and fluid accumulation are linked to visual impairment.

Table 3: Correlation Between Morphological and Functional Parameters

Parameter	BCVA (logMAR)	Contrast Sensitivity	Retinal Sensitivity (MP-A)
Central Retinal Thickness (CRT)	0.18 ($p = 0.28$)	–0.32 ($p = 0.05$)*	–0.61 ($p = 0.001$)**
Subretinal Fluid Height (SRF)	0.34 ($p = 0.02$)*	–0.44 ($p = 0.02$)*	–0.70 ($p < 0.001$)**
Macular Volume (MV)	0.40 ($p = 0.005$)**	–0.38 ($p = 0.03$)*	–0.62 ($p = 0.001$)**

**** Significant at $p < 0.05$ ** Highly significant at $p < 0.01$***

Multiple linear regression analysis was conducted to identify key predictors of BCVA impairment among morphological and functional variables. The model was statistically significant ($R^2 = 0.65$, Adjusted $R^2 = 0.62$, $p < 0.001$).

Retinal sensitivity ($\beta = –0.52$, $p < 0.001$) emerged as the strongest predictor of visual function loss. Macular volume ($\beta = 0.40$, $p = 0.005$) and subretinal fluid height ($\beta = 0.34$, $p = 0.02$) also had significant effects on BCVA, whereas central retinal thickness showed no significant association.

Table 4: Regression Analysis for Predictors of Visual Function Impairment

Predictor Variable	β (Standardized Coefficient)	t-value	p-value
Central Retinal Thickness (CRT)	0.18	1.10	0.28
Subretinal Fluid Height (SRF)	0.34	2.45	0.02*
Macular Volume (MV)	0.40	3.21	0.005**
Retinal Sensitivity (MP-A)	–0.52	–4.01	<0.001**

Model Summary: $R^2 = 0.65$, Adjusted $R^2 = 0.62$, $p < 0.001$ (Model significant)
**** Significant at $p < 0.05$ ** Highly significant at $p < 0.01$***

DISCUSSION

This study used Spectral-Domain Optical Coherence Tomography (SD-OCT) to evaluate the morphological characteristics of Central Serous Chorioretinopathy (CSC) and to determine how these structural changes correlate with disease duration and visual function. By assessing OCT parameters alongside visual outcomes, this study aimed to identify reliable predictors of functional impairment in CSC and to distinguish morphological differences between acute and chronic cases. The findings were compared with published literature to provide a comprehensive understanding of the disease's clinical and structural spectrum.

The prevalence of CSC among patients attending the Ophthalmology Outpatient Department in this study was 1.5%, consistent with previously reported rates. Imamura et al,[5] (2009) documented a similar prevalence of 1.7% in Japanese outpatients, while Spaide et al.6 (1996) estimated that CSC accounts for 1–2% of all retinal disorders. Kitzmann et al,[7] (2008) and Haimovici et al,[8] (2004) reported comparable hospital-based rates ranging from 0.6% to 2%, suggesting that the present findings align with global trends. These results reaffirm that CSC is a relatively common cause of macular pathology among middle-aged adults, particularly those under occupational or psychological stress.

The mean age of affected individuals was 45.3 ± 8.7 years, with most cases observed between 40 and 49 years of age. This finding matches reports by Kitzmann et al,[7] (2008), who identified a peak incidence between 40 and 55 years, and by Maruko

et al,[9] (2011) and Liew et al,[10] (2013), who noted that CSC rarely occurs before the age of 30 and becomes less common after 60. The current results support the understanding that CSC primarily affects middle-aged adults, possibly due to cumulative effects of stress hormones, vascular changes, and metabolic activity in the choroid.

A marked male predominance (75%), corresponding to a 3:1 male-to-female ratio, was observed. This is consistent with prior studies by Imamura et al,[5] (2009) and Maruko et al,[9] (2011), who reported male predominance rates of 70–80%, and by Haimovici et al,[8] (2004), who found a 6:1 ratio. Kitzmann et al,[7] (2008) attributed this trend to hormonal influences, while Ooto et al,[11] (2010) and Yalcinbayir et al,[12] (2014) suggested that higher testosterone and stress levels increase susceptibility in men. Liew et al,[10] (2013) also proposed that CSC may be underdiagnosed in women due to milder symptoms or delayed presentation. The predominance of male patients in this study is consistent with global data, confirming the influence of gender-related biological and behavioral factors.

Regarding clinical presentation, the majority of patients (43.8%) reported symptoms lasting 1–3 months, with a mean duration of 2.4 ± 1.1 months. Chronic CSC, defined as symptoms persisting for more than 6 months, accounted for 12.5% of cases. These findings are in line with Haimovici et al,[8] (2004), who reported that 80–90% of acute CSC cases resolve spontaneously within three months, while 10–15% progress to chronic disease. The low rate of chronicity observed here mirrors the natural history described in earlier studies, emphasizing the self-limiting nature of most acute CSC episodes.

Blurring of vision was the most common symptom (87.5%), followed by metamorphopsia (59.4%) and scotoma (50.0%). Similar findings were reported by Oishi et al,[13] (2010) and Fujimoto et al,[14] (2008), who described blurring as the predominant complaint in acute CSC. Micropsia (37.5%) and hypermetropic shift (31.3%) were also noted, consistent with Song et al,[19] (2012), who attributed these symptoms to anterior displacement of the neurosensory retina. Unilateral involvement (71.9%) was significantly more common than bilateral (28.1%), which aligns with reports by Imamura et al,[5] (2009) and Oishi et al,[13] (2010). However, Spaide et al,[6] (1996) and Iida et al,[15] (1999) demonstrated that subclinical choroidal abnormalities often exist in the fellow eye, indicating that CSC may represent a bilateral choroidal dysfunction with unilateral manifestation.

SD-OCT provided detailed visualization of retinal morphology, identifying hallmark features of CSC. Serous neurosensory detachment was the most frequent OCT finding (93.8%), followed by subretinal fluid accumulation (81.3%) and choroidal thickening (>300 µm) (84.4%). These findings corroborate those of Song et al,[19] (2012) and Ooto et al,[11] (2010), who described these changes as key diagnostic markers of acute CSC. The presence of choroidal thickening supports Spaide et al,[6] (1996) hypothesis that choroidal vascular hyperpermeability is central to CSC pathogenesis. Imamura et al.[5] (2009), using enhanced depth imaging (EDI), confirmed that subfoveal choroidal thickness is significantly greater in CSC eyes than in normal eyes. Pigment epithelial detachment (PED) was observed in 68.8% of cases, a frequency comparable to that reported by ShinOjima et al,[16] (2010) (71%). Fujimoto et al,[14] (2008) noted that PED commonly occurs at sites of fluorescein leakage, while Montero and Ruiz-Moreno,[17] (2005) described small RPE protrusions consistent with those seen here. Disruption of the inner segment/outer segment (IS/OS) junction was identified in 43.8% of cases, consistent with studies by Ooto et al,[11] (2010) and Yalcinbayir et al,[12] (2014), who linked photoreceptor integrity to visual prognosis. Hyperreflective dots, seen in 37.5% of patients, were consistent with findings by Kon et al,[18] (2008), who attributed them to subretinal fibrin or inflammatory deposits.

When comparing acute and chronic CSC, significant differences were observed in morphological and functional parameters. Central retinal thickness (CRT) was higher in acute cases (480.2 ± 110.3 µm) than in chronic ones (420.1 ± 90.4 µm; $p = 0.045$), consistent with progressive thinning described by Song et al,[19] (2012) and Matsumoto et al,[20] (2009). Subretinal fluid height (SRF) was also greater in acute cases (250.4 ± 98.7 µm) than in chronic ones (160.3 ± 75.2 µm; $p = 0.011$), similar to Ojima et al,[21] (2007), who reported that fluid volume decreases as RPE function improves over time. Macular volume (MV) was significantly higher in acute CSC (3.30 ± 0.60 mm^3) compared to chronic CSC (2.85 ± 0.50 mm^3; $p = 0.034$), consistent with Fujimoto et al,[14] (2008) and Sun et al. (2014), who found progressive macular thinning in chronic cases.

Functional outcomes also differed between acute and chronic cases. Best-corrected visual acuity (BCVA) was poorer in chronic CSC (0.25 ± 0.12 logMAR) compared to acute (0.15 ± 0.08 logMAR; $p = 0.021$). Retinal sensitivity was significantly lower in chronic CSC (7.8 ± 2.9 dB) than in acute cases (12.1 ± 3.8 dB; $p = 0.002$). These results agree with studies by Ojima et al,[21] (2007) and Fujimoto et al,[14] (2008), who attributed functional decline to photoreceptor loss and outer retinal disruption in long-standing disease.

Correlation analysis demonstrated that retinal sensitivity had the strongest inverse correlation with BCVA ($r = –0.52$, $p < 0.001$), followed by macular volume ($r = 0.40$, $p = 0.005$) and subretinal fluid height ($r = 0.34$, $p = 0.02$). Central retinal thickness showed a weaker correlation ($r = 0.18$, $p = 0.28$), indicating that overall thickness is less predictive of visual function. These results are consistent with Yalcinbayir et al,[12] (2014), who emphasized that photoreceptor integrity is a more accurate predictor of vision than retinal thickness alone. Regression analysis identified retinal sensitivity ($\beta = –0.52$, $p < 0.001$) as the strongest independent predictor of

BCVA, followed by macular volume (β = 0.40, p = 0.005) and subretinal fluid height (β = 0.34, p = 0.02). Similar findings were reported by Ooto et al,[11] (2010), Oishi et al,[13] (2010), and Maruko et al,[9] (2011), who highlighted the importance of preserving photoreceptor and macular structure for visual recovery.

CONCLUSION

This study highlights the prevalence, demographic distribution, clinical features, and OCT findings of CSR, emphasizing its higher occurrence in middle-aged males. Most cases presented within three months, with blurring of vision as the predominant symptom. OCT findings confirmed characteristic retinal changes, with retinal sensitivity being the strongest predictor of visual impairment. The study underscores the importance of early diagnosis and SD-OCT in assessing disease severity and guiding management for better visual outcomes.

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