# The Foveal Photoreceptor Layer and Visual Acuity Loss in Central Serous Chorioretinopathy

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• PURPOSE: **To describe changes of the foveal photoreceptor layer using optical coherence tomography (OCT) in central serous chorioretinopathy (CSC) and evaluate the correlation with visual acuity (VA) loss.**

• DESIGN: **Observational case series.**

• METHODS: **We studied 28 eyes with acute or chronic CSC using high-resolution OCT. The tomographic findings of the detached foveal photoreceptor layer were compared with VA. Sixteen eyes also were evaluated after foveal reattachment.**

• RESULTS: **The outer photoreceptor layer (OPL) in the detached fovea was preserved in 14 eyes, of which 13 had symptoms for <1 year and atrophic in 14 eyes with symptoms for >1 year. The preserved OPL had an even profile in 7 eyes and a granulated profile in 7 eyes. Mean VA was 0.19 logMAR with a preserved OPL and 0.72 logMAR with an atrophic OPL ($P$ <.001). Cases seen after the detachment resolved included 6 eyes with preserved even OPL, 5 eyes with preserved granulated OPL, and 5 eyes with atrophic OPL. Mean final VA was 0.06 logMAR in eyes with preserved OPL and 0.90 logMAR in eyes with atrophic OPL ($P$ <.001). The VA improved in 73% of eyes with preserved OPL and no eyes with atrophic OPL ($P$ = .025). The VA recovered completely in 83% of eyes with preserved even OPL and no eyes with preserved granulated OPL ($P$ = .015).**

• CONCLUSION: **High-resolution OCT demonstrates changes in the foveal photoreceptor layer in CSC that highly correlate with VA loss and may predict visual recovery after macular reattachment.** **(Am J Ophthalmol 2005;139:87-99. © 2005 by Elsevier Inc. All rights reserved.)**

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CENTRAL SEROUS CHORIORETINOPATHY (CSC) IS characterized by idiopathic retinal detachment at the posterior pole caused by passage of fluid from the choroid to the subretinal space through a barrier defect in the retinal pigment epithelium.[1,2] The disease often resolves spontaneously but sometimes recurs or becomes chronic.[1–3] In cases of recent onset, central vision is minimally affected and usually returns to normal after reabsorption of the subretinal fluid. In recurrent and chronic cases, progressive and irreversible visual decline can be associated with the development of central retinal pigment epithelium atrophy, cystoid macular degeneration, and foveal atrophy.[3–6]

Recently, optical coherence tomography (OCT) has been used to evaluate changes in the retina in cases of acute and chronic CSC.[5–8] Retinal thickening was detected in association with serous detachment in acute cases.[8] Foveal attenuation or cystoid degeneration was reported after resolution of the detachment in eyes with persistent visual loss.[5,6] However, the process of visual deterioration due to persistence of the serous macular detachment in CSC is not clear. The photoreceptors might have a critical role in this process because they are separated from their source of nutrients when the retina is detached. The third-generation OCT system has a high-resolution capability and allows for good quality images of the retinal layers in the macula. Using this system, we investigated the pathologic changes in the photoreceptor layer in patients with CSC to determine the mechanism of visual loss in this disease.

In this study, we describe the tomographic findings in the photoreceptor layer associated with macular detachment in CSC. These findings appear to correlate with visual acuity (VA) during active disease and to predict the visual outcome after macular reattachment.

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## PATIENTS AND METHODS

WE PROSPECTIVELY STUDIED 28 EYES OF 28 CONSECUTIVE patients with CSC examined between November 2002 and November 2003. The study was performed in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants. The diagnosis of CSC was based on the presence of serous macular detachment documented by OCT and leakage from the retinal pigment epithelium on fluorescein angiography and the absence of other chorioretinal disorders that can cause macular exudation such as drusen, pathologic myopia, intraocular inflammation, retinal vasculopathies, angioid streaks, trauma, and hereditary dystrophies. Cases with acute or chronic CSC were included. Acute CSC was defined as a serous macular detachment caused by one or several isolated leaks seen on fluorescein angiography at the level of the retinal pigment epithelium. Chronic CSC was defined as a serous macular detachment associated with areas of retinal pigment epithelium atrophy and pigment mottling, visible biomicroscopically, where fluorescein angiography displayed subtle leaks or ill-defined staining.[9] Patients who had fibrinous subretinal exudation were excluded, because the reflectivity of fibrin could merge with the outer retinal reflectivity and bias the tomographic evaluation. Patients with cystoid macular degeneration and choroidal neovascularization, possible causes of visual loss in chronic CSC, also were excluded.

All patients had a complete ophthalmologic examination, including fundus biomicroscopy with the three-mirror Goldman lens. Best-corrected visual acuity (BCVA) was measured with the modified Early Treatment Diabetic Retinopathy Study charts. Visual results were quantitated using the logarithm of the minimal angle of resolution (logMAR). All patients underwent fluorescein and indocyanine green (ICG) angiography using the TRC-50 IA/IMAGEnet H1024 system (Topcon, Tokyo, Japan) or the Heidelberg scanning laser ophthalmoscope (Heidelberg Engineering, Heidelberg, Germany). Examinations performed with the Heidelberg system included preinjection photographs taken with filters for fluorescein to detect autofluorescence.[10] OCT was performed using the Humphrey-Zeiss model 3000 instrument (Zeiss AG, Oberkochen, Germany). This system obtains good images of the intraretinal cross-sectional anatomy with delineation of the photoreceptor layer. In a normal macula, the photoreceptor layer corresponds to a weak band of backscattering in the outer part of the OCT sections.[11,12] The junction of the inner and outer segments of the photoreceptors has been visualized with ultra-high-resolution OCT as a hyperreflective layer distinct from the adjacent retinal pigment epithelium reflectivity.[13–15] Separation from the retinal pigment epithelium is particularly evident in the central fovea, where the length of the outer cone segments increases.[13,14] The third-generation OCT currently in use also can resolve the outer photoreceptor layer (OPL) and produces a signal distinct from the retinal pigment epithelium at the fovea. With this system, we acquired horizontal and vertical scans 3 and 5 mm in length centered on the foveal region in all eyes and evaluated the morphologic characteristics of the photoreceptor layer.

After the initial examination, patients were reexamined for 4 to 12 months (mean 6.6 ± 3.1 months). Sixteen eyes also were studied after the macular detachment resolved; this occurred spontaneously in three eyes and after laser photocoagulation in nine eyes or after photodynamic therapy (PDT) in four eyes. Thermal laser was applied on extrafoveal retinal pigment epithelium leaking points. PDT was performed with extrafoveal laser spots in eyes with ill-defined leakage from the retinal pigment epithelium based on recent reports.[16,17]

*Definitions:* The following definitions were used to describe the changes in the OPL within the detachment. The preserved OPL is that in which an outer reflective band of the detached retina is detected in continuity with the outer reflective line of the photoreceptors outside the detachment. The preserved detached OPL could have an even or a granulated profile. In the latter, the thickness of the OPL changed along the detachment with a granulated appearance. An atrophic OPL refers to the loss of tissue in the detached OPL, which is apparent from the discontinuity of or absence of the outer reflectivity of the photoreceptors.

*Scan Evaluation:* Two authors (R.R.L., C.M.E.) evaluated the OCT scans and categorized each eye based on the definitions. In cases of disagreement, a referee (F.C.P.) broke the tie. When a combination of changes was present in the same macular detachment, the categorization was based on the condition of the OPL at the central fovea. The ability to visualize the junction of the inner and outer segments after macular reattachment was evaluated. The final foveal thickness after reattachment, defined as the distance between the inner retinal surface and the retinal pigment epithelium at the central fovea, was measured by a single examiner. The mean value obtained from three foveal scans, each 3-mm long, was used for the study. The scan-to-scan reproducibility of the retinal thickness measurements had a margin of error of 6%. The examiners were masked to the VA when the OCT images were evaluated.

*Statistical Analysis:* Analysis of variance (ANOVA) and successive multiple comparisons (Scheffé test) were used to compare the mean BCVA during foveal detachment and after resolution of the detachment in eyes with a preserved photoreceptor layer with the BCVA in eyes with atrophy. Two-way ANOVA was used to evaluate whether atrophy of the retinal pigment epithe-