Full-Thickness Macular Hole Following the Development of a Foveal Crack Sign After Rhegmatogenous Retinal Detachment Surgery

Betul Kirbas Sarac[1], *Pinar Cicek Kaya*[1], *Berrak Sekeryapan Gediz*[1]

ABSTRACT

We report the case of a 64-year-old male who developed a full-thickness macular hole (FTMH) following rhegmatogenous retinal detachment (RRD) surgery, with the foveal crack sign (FCS) detected as a preceding structural alteration on optical coherence tomography (OCT). The patient initially underwent pars plana vitrectomy with C3F8 tamponade for RRD associated with a superonasal horseshoe retinal tear, achieving successful reattachment and visual improvement. At six months postoperatively, OCT revealed a vertical hyperreflective line at the foveal center, consistent with FCS, while best-corrected visual acuity (BCVA) was 0.4. By twelve months, BCVA had declined to 0.1, and OCT demonstrated the development of an FTMH. A second vitreoretinal surgery with internal limiting membrane peeling and gas tamponade resulted in successful closure of the macular hole and visual recovery to 0.4. This case highlights the clinical significance of FCS as an early OCT biomarker that may precede macular hole formation after RRD repair. Careful postoperative OCT monitoring in patients with FCS may enable the timely recognition of high-risk eyes and facilitate earlier surgical intervention to improve visual prognosis.

Keywords: Foveal crack sign; Macular hole; Rhegmatogenous retinal detachment; Optical coherence tomography; Vitrectomy

INTRODUCTION

The occurrence of a full-thickness macular hole (FTMH) following rhegmatogenous retinal detachment (RRD) surgery is a rare postoperative complication with significant implications for visual outcomes .[1,2] Despite its rarity, this condition remains clinically significant as it frequently requires additional surgical intervention. [3] The pathogenesis of secondary FTMH following RRD surgery is considered multifactorial. [2,3] With the advent of high-resolution spectral-domain optical coherence tomography (SD-OCT), previously unrecognized structural alterations at the fovea have become identifiable. [3-5] One notable finding is the so-called *foveal crack sign* (FCS), characterized by a vertical hyperreflective line traversing the inner retinal layers at the foveal center.[6,7] This OCT finding is hypothesized to reflect localized stress and microdisruption of Müller cells subjected to biomechanical strain and it has been proposed as a potential biomarker that may precede FTMH formation. [6-9] The present case details the emergence of FCS following pars plana vitrectomy (PPV) with C3F8 tamponade for RRD, subsequent progression to secondary FTMH, and discusses its clinical relevance within the context of existing literature.

1 Etlik City Hospital, Ophtalmology, Ankara, Türkiye

Received: 11.10.2025
Accepted: 30.01.2026
J Ret-Vit 2026; 35: 79-83
DOI:10.37845/ret.vit.2026.35.11

Correspondence author:
Betul Kirbas Sarac
Email: kirbasbetul@gmail.com

Copyright © 2026 The author(s). This is an open-access article under the terms of the Creative Commons Attribution License (CC BY) which permits unrestricted use, distribution, and reproduction in any medium or format, provided the original work is properly cited.

CASE REPORT

A 64-year-old male patient was referred to our clinic with a complaint of sudden-onset visual loss in the left eye. His ophthalmic and systemic medical history was unremarkable. Upon examination, best-corrected visual acuity (BCVA) was 1.0 in the right eye and limited to hand motion in the left eye. Intraocular pressure measured 11 mmHg in the right eye and 12 mmHg in the left eye. Slit-lamp examination revealed pseudophakia bilaterally. Dilated fundus examination of the right eye was unremarkable. In the left eye, a superonasal horseshoe retinal tear associated with rhegmatogenous retinal detachment (RRD) extending into the posterior pole was observed.The patient underwent pars plana vitrectomy (PPV) with endolaser photocoagulation surrounding the retinal break and 14% perfluoropropane (C3F8) gas tamponade in the left eye. The early postoperative period was uneventful, and successful retinal reattachment was achieved.At the one-month postoperative follow-up, optical coherence tomography (OCT) did not demonstrate a definite foveal crack sign; however, subtle vertical hyperreflective irregularity and elongation at the foveal center were retrospectively noted (Figure 1a).At the six-month follow-up, BCVA improved to 0.4, OCT revealed a distinct vertical hyperreflective line traversing the central fovea, consistent with the foveal crack sign (Figure 1b).Central foveal thickness measurements showed 260 µm at postoperative month 1 and 240 µm at month 6, while the fellow eye demonstrated a thickness of 265 µm, supporting subtle quantitative changes accompanying the observed OCT findings.At the twelve-month follow-up, BCVA declined to 0.1, and OCT imaging demonstrated the development of a full-thickness macular hole (FTMH) at the foveal center (Figure 1c).The patient subsequently underwent a second PPV with internal limiting membrane (ILM) peeling and C3F8 gas tamponade.Color fundus photography of the fellow eye demonstrated a normal retinal appearance (Figure 2a), and OCT confirmed normal foveal architecture in the right eye (Figure 2b).In the operated eye, fundus imaging demonstrated closure of the macular hole, intravitreal gas tamponade, and well-defined laser photocoagulation scars surrounding the retinal tear (Figure 2c). Three months after macular hole surgery, OCT confirmed successful anatomical closure and restoration of the foveal contour, with BCVA improving to 0.4 (Figure 2d).

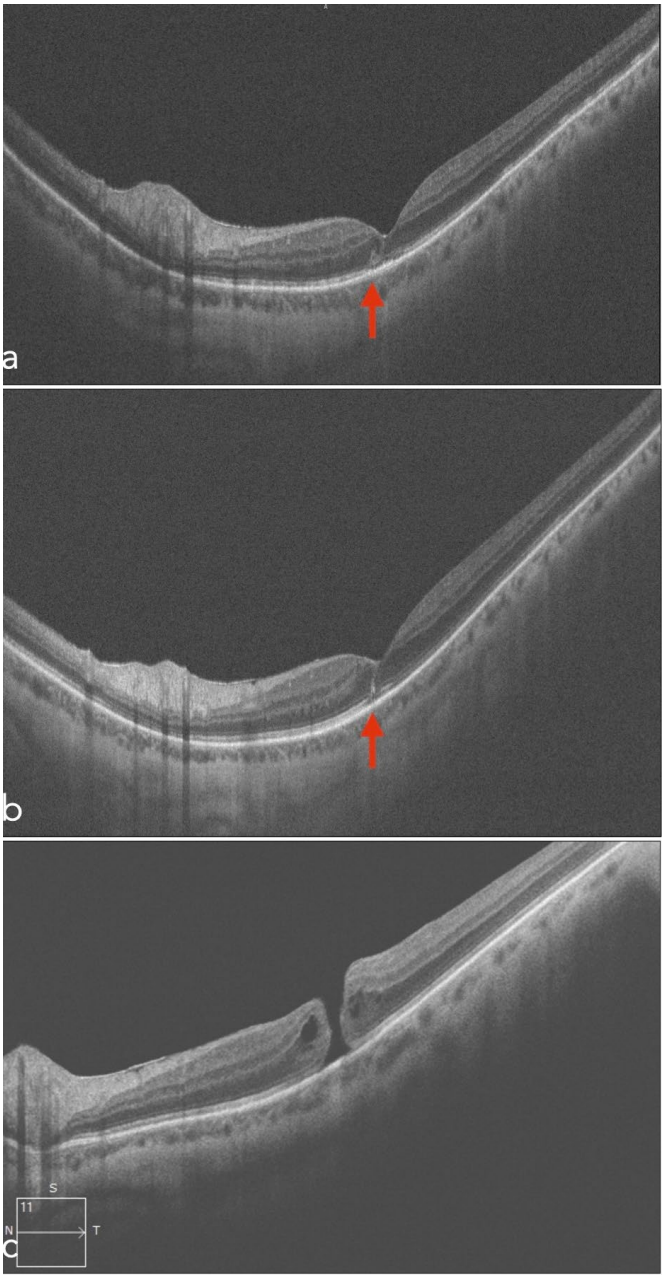

Figure 1. *Sequential optical coherence tomography (OCT) images of the operated eye demonstrating the temporal progression of foveal changes after rhegmatogenous retinal detachment surgery. (a) At postoperative month 1, OCT shows subtle vertical hyperreflective irregularity and elongation at the foveal center (arrow), without a definite foveal crack sign. (b) At postoperative month 6, a distinct vertical hyperreflective line traversing the central fovea is observed, consistent with the foveal crack sign (arrow). (c) At postoperative month 12, OCT demonstrates the development of a full-thickness macular hole, with complete interruption of the retinal layers at the foveal center.*

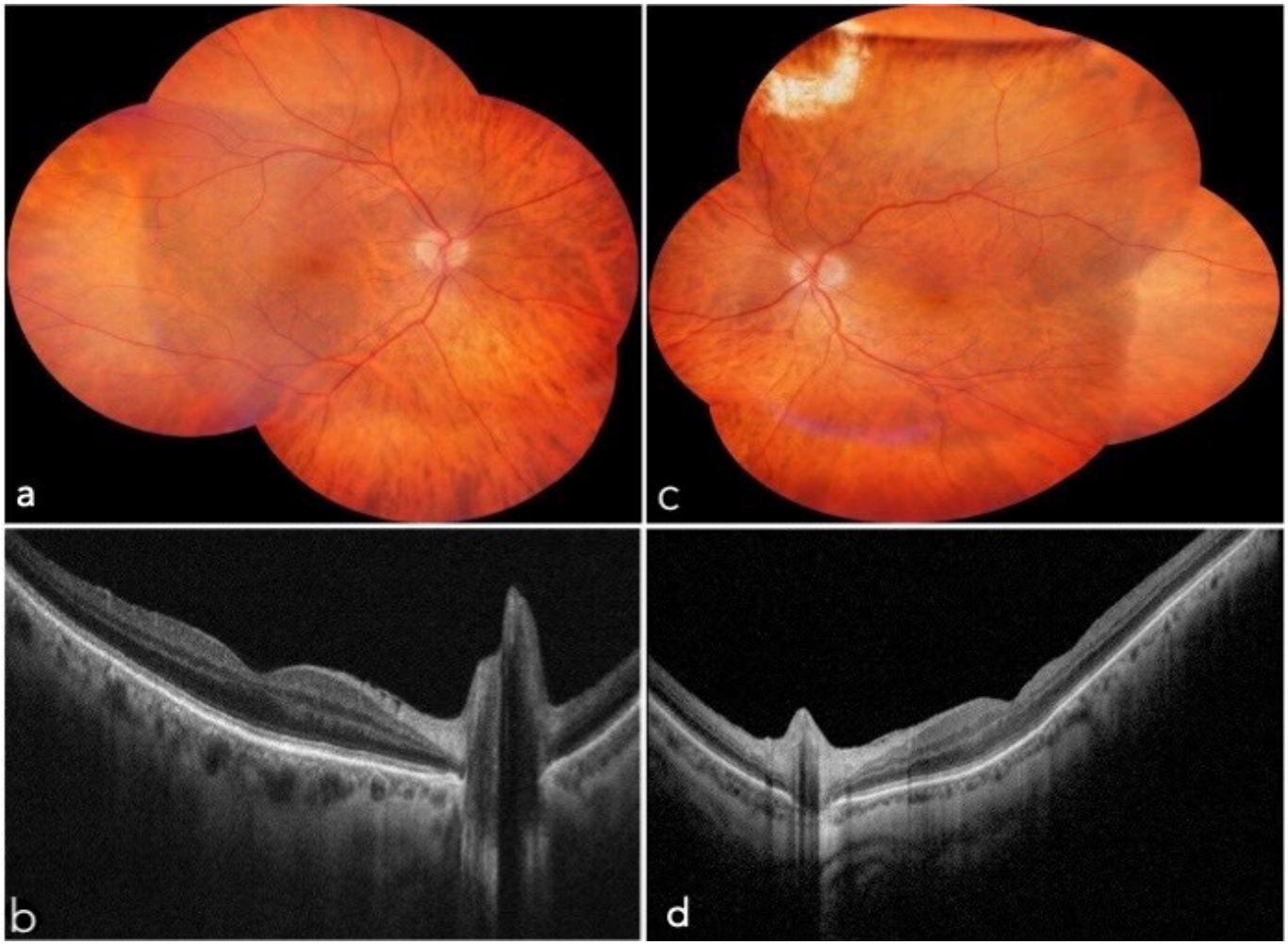

Figure 2. *Comparative imaging of the fellow and operated eyes. (a) Color fundus photograph of the fellow eye showing a normal optic disc and macular appearance. (b) Optical coherence tomography of the fellow eye demonstrating normal foveal architecture. (c) Color fundus photograph of the operated eye demonstrating anatomical success after surgery, with a flat macula and well-defined laser photocoagulation scars surrounding the retinal tear. (d) Postoperative optical coherence tomography of the operated eye confirming successful closure of the macular hole with restoration of the foveal contour.*

DISCUSSION

RRD is one of the most vision-threatening conditions in ophthalmology, characterized by the separation of the neurosensory retina from the retinal pigment epithelium due to the ingress of liquefied vitreous fluid through a retinal break .[10] The annual incidence of RRD has been estimated at 1 in 10,000 persons, with a higher prevalence among myopic and pseudophakic patients .[10,11] Despite significant advances in vitreoretinal surgery, including PPV, endolaser photocoagulation, and long-acting gas tamponades such as C3F8, anatomical success does not invariably translate into optimal functional recovery, particularly in cases involving the macula.[1,10,11] FTMH formation represents a rare but clinically significant complication following RRD repair, with reported incidences ranging from 0.5% to 2.8%.[2,8] Previous studies have documented secondary macular hole formation following PPV for RRD. Rahman et al.[12] reported that macular holes may develop months after anatomically successful retinal reattachment and suggested that tangential traction, cystoid macular degeneration, and progressive foveal structural weakening may contribute to this process. Similarly, Medina et al.[13] described a series of patients who developed FTMH after vitrectomy for RRD,

often in the absence of recurrent detachment, emphasizing the role of postoperative vitreoretinal interface alterations and delayed foveal instability. These observations indicate that macular hole formation after RRD repair is not an isolated event but may represent the cumulative effect of mechanical and microstructural stress at the fovea.OCT plays a pivotal role in identifying subtle preclinical macular changes preceding overt macular hole formation. The characteristic vertical hyperreflective line seen in FCS is thought to represent localized disruption of the inner retinal layers at the fovea, potentially reflecting microstructural stress or degeneration of Müller cells.[13,14]. Ishibashi et al.[8] first described the prognostic significance of FCS, demonstrating that all eyes developing postoperative FTMH after PPV for RRD exhibited this sign beforehand,with a mean interval of approximately 255 days to FCS appearance and 232 days from FCS detection to macular hole formation. [8] Subsequent studies by Furashova et al.[9] and Lee et al.[15] further demonstrated that the coexistence of FCS with persistent vitreoretinal adhesion markedly increases the risk of FTMH development.[9,15] These findings highlight the clinical importance of early recognition of FCS, particularly in macula-on RRD cases where the foveal architecture appears preserved.More recently, Rodriguez and Browning [16] emphasized that the clinical significance of FCS may vary depending on the underlying retinal pathology and surgical context. They proposed that FCS reflects stress-related microstructural degeneration involving Müller cells and the outer retinal layers and noted that FCS does not uniformly progress to FTMH in non-vitrectomized eyes. Importantly, they suggested that FCS has greater predictive value in eyes that have undergone PPV, particularly following RRD repair, where postoperative biomechanical alterations may predispose the fovea to structural failure. [16] This mechanistic framework provides a plausible explanation for delayed macular hole formation despite anatomically successful retinal reattachment. In addition to microstructural degeneration reflected by the FCS, several postoperative factors have been proposed to contribute to FTMH formation after vitrectomy for RRD. These include epiretinal membrane development, residual vitreous base traction, and persistent microtubular stress at the fovea following fluid–gas exchange, all of which may exacerbate foveal instability in susceptible eyes.[12,13,15] The present case expands upon previous observations by demonstrating that subtle foveal microstructural alterations may precede the appearance of a definite foveal crack sign. Retrospective OCT analysis revealed faint vertical hyperreflective irregularities at the foveal center as early as postoperative month 1, followed by a distinct FCS at month 6 and subsequent FTMH formation at month 12. This clearly documented temporal sequence suggests that foveal vulnerability may begin earlier than the clinically recognized FCS stage and highlights a potential window for intensified OCT surveillance. From a clinical perspective, recognition of early OCT abnormalities and established FCS may facilitate timely identification of high-risk eyes and prompt intervention once macular hole formation is detected. In our case, early surgical management resulted in successful anatomical closure and meaningful visual recovery, supporting the integration of longitudinal OCT monitoring into postoperative follow-up protocols for patients undergoing PPV for RRD.[15-17]

CONCLUSION

The FCS represents an important OCT biomarker associated with subsequent FTMH development following RRD surgery. This case suggests that subtle foveal microstructural changes may precede the appearance of a definite FCS, underscoring the value of meticulous, longitudinal OCT surveillance. Early recognition of such changes may aid in identifying eyes at increased risk for delayed macular hole formation and support timely clinical decision-making. Further prospective studies are warranted to elucidate the mechanisms underlying these early alterations and to refine postoperative monitoring strategies.

Patient Consent:

Written informed consent was obtained from the patient for publication of this case and accompanying images.

Conflict of Interest:

The authors declare that they have no conflict of interest.

Funding:

No financial support was received for this study.

REFERENCES

1. Feltgen N, Walter P. Rhegmatogenous retinal detachment—an ophthalmologic emergency. Dtsch Arztebl Int. 2014;111(1–2):12–21.
2. Fabian ID, Moisseiev E, Moisseiev J, et al. Macular hole after vitrectomy for primary rhegmatogenous retinal detachment. Retina. 2012;32(3):511–519.
3. Christensen UC, Krøyer K, Sander B, et al. Macular morphology and visual acuity after macula-off retinal detachment surgery. Retina. 2009;29(3):318–326.
4. Gharbiya M, Grandinetti F, Scavella V, et al. Correlation between spectral-domain optical coherence tomography findings and visual outcome after surgery for rhegmatogenous retinal detachment. Retina. 2012;32(1):43–53.
5. Coppola M, Marchese A, Cicinelli MV, et al. Macular optical coherence tomography findings after vitreoretinal surgery for rhegmatogenous retinal detachment. Eur J Ophthalmol. 2020;30(4):805–816.
6. Govetto A, Bhavsar KV, Virgili G, et al. Tractional abnormalities of the foveal architecture: review of the literature and new insights into pathogenesis. Retina. 2017;37(9):1464–1477.
7. Bringmann A, Syrbe S, Görner K, et al. The primate fovea: structure, function and development. Prog Retin Eye Res. 2018;66:49–84.
8. Ishibashi T, Iwama Y, Nakashima H, et al. Foveal Crack Sign: an OCT sign preceding macular hole after vitrectomy for rhegmatogenous retinal detachment. Am J Ophthalmol. 2020;218:192–198.
9. Furashova O, Matthé E. Foveal crack sign as a predictive biomarker for development of macular hole in fellow eyes of patients with full-thickness macular holes. Sci Rep. 2020;10(1):19932.
10. Mitry D, Charteris DG, Fleck BW, et al. The epidemiology of rhegmatogenous retinal detachment: geographical variation and clinical associations. Br J Ophthalmol. 2010;94(6):678–684.
11. Wong TY, Tielsch JM, Schein OD, et al. Racial difference in the incidence of retinal detachment in Singapore. Arch Ophthalmol. 1999;117(3):379–383.
12. Rahman W, Georgalas I, da Cruz L. Macular hole formation after vitrectomy for retinal detachment. Acta Ophthalmol. 2010;88(4):e147–e148.
13. Medina CA, Ortiz AG, Relhan N, et al. Macular hole after pars plana vitrectomy for rhegmatogenous retinal detachment. Retina. 2017;37(6):1065–1072.
14. Govetto A, Hubschman J, Sarraf D, et al. The role of Müller cells in tractional macular disorders: an optical coherence tomography study and physical model of mechanical force transmission. Br J Ophthalmol. 2020;104:466–472.
15. Lee S, Kang E, Choi M. The outer nuclear layer changes in full-thickness macular holes according to the restoration of the outer retinal layer postoperatively. Graefes Arch Clin Exp Ophthalmol. 2025.
16. Rodriguez R, Browning DJ. Foveal crack sign and macular pattern dystrophy. Int J Retin Vitr. 2025;11:31.
17. Joe SG, Kim YJ, Chae JB, et al. Structural recovery of the detached macula after retinal detachment repair as assessed by optical coherence tomography. Korean J Ophthalmol. 2013;27(3):178–185.