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Case Report

Multiple Types Late-Onset Postoperative Retinal Folds following Vitrectomy for Retinal Detachment Repair with Silicone Oil: Morphologic Variability and Optical Coherence Tomography Angiography Features – A Case Report

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Keywords
Retinal folds · Retinal detachment · Silicone oil · Optical coherence tomography angiography

Abstract
Introduction: Retinal folds (RFs) may develop following rhegmatogenous retinal detachment (RRD) repair, though it consists an uncommon complication. ***Case Presentation:*** Herein, we present a case of late-onset postoperative outer RFs with aggravating characteristics following vitrectomy with silicone oil (SO) tamponade for RRD repair; early clinical findings, complications, anatomical and functional status during a 12-month follow-up period are described. Retinal imaging by acquiring optical coherence tomography scans and angiograms indicates detailed morphological and angiographic characteristics of the evolution of RFs over time. Our case provides insight into a combination of various types of RFs along with retinal disorganization with appearance in the late postoperative period after RRD repair with SO tamponade. ***Conclusion:*** Our aim was to raise awareness of the pathological processes that may be associated with the development and evolution of RFs after successful RRD repair, indicating that it is critical to accurately diagnose the type of RFs and closely monitor their progression in an attempt to provide prognostication for future visual outcomes.

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Introduction

Retinal folds (RFs) may develop following rhegmatogenous retinal detachment (RRD) repair, though it consists an uncommon complication. Patients typically present with visual disturbance including metamorphopsia, diplopia, and visual field defect in foveal-involving folds, while peripheral folds may be asymptomatic. Clinical evaluation of the extent of tissue involved in a RF (full- vs. partial-thickness) may be notably challenging, while the natural history and optimal management of different types of folds apparently differ [1].

Numerous risk factors (residual subretinal fluid [SRF], larger volume of gas tamponade, or postoperative posturing) have been proposed to be implicated in the formation of RFs. Due to the mobility and elasticity of the retinal tissue, the later may be displaced from the initial topographical position after reattachment [1]. Interestingly, RFs have been mainly described in the early postoperative period after scleral buckling and vitrectomy with gas tamponade or silicone oil (SO) [1].

Advanced retinal imaging has provided insight in our understanding of the morphological characteristics of RFs. The advent of optical coherence tomography (OCT) has contributed to acquisition of in vivo structural data and detailed morphological evaluation, while the evolution of RFs during time remains an undetermined aspect. Indeed, variable terminology has been used to describe these folds, namely, posterior RFs, arcuate RFs, retinal compression folds, dry RFs, or macular folds [1].

The purpose of this report was to present a case of postoperative late-onset outer RFs (ORFs) with aggravating characteristics following vitrectomy with SO tamponade for RRD repair; early clinical findings, complications, anatomical and functional status during a 12-month follow-up period are herein described. Retinal imaging by acquiring OCT scans and angiograms indicates detailed characteristics of the evolution of RFs over time. To our best knowledge, our case is distinct in that RFs developed in the long term after RRD repair with intravitreal SO and not in the early postoperative period, while both morphological and angiographic characteristics are delineated in detail.

Case Presentation

A 72-year-old male patient presented to our department, complaining of blurred vision in his only seeing left eye (LE). The patient's right eye was lost to a childhood accident. Visual acuity (VA) in the LE was 1/10 Snellen and a complete ophthalmologic examination revealed a pseudophakic, macula split superior RRD extending linearly from 11th to 5th clock hour with a single retinal break at the superior temporal quadrant. We proceeded into a 25 G pars plana vitrectomy, endolaser photocoagulation to seal off the retinal break and SO tamponade of 1,200 cs. The patient was instructed to keep face-down head posturing for 24 h postoperatively and on a regime of 8 h per day for the following 6-day period, divided into 4 h in the morning and as many hours in the afternoon, as well as to avoid supine position overnight.

Regular examination visits were performed, based on protocol, and color fundus pictures as well as spectral domain (SD) OCT and OCT-angiography were acquired at each visit. At 1 week postoperatively, VA was 5/10 with flat retina and a shallow layer of SRF spread across the line of the former detachment (Fig. 1). In the following examinations, VA gradually decreased to 3/10 and to 1/10 at 2 and 3 months postoperatively, respectively, accompanied by severe metamorphopsia. The gradual visual loss was accompanied by the disorganization of the retinal layers and the late development of inner RFs and ORFs, along with the formation of an epiretinal membrane (ERM) (Fig. 2, 3). The RFs had mixed features of "ripple" and "taco"

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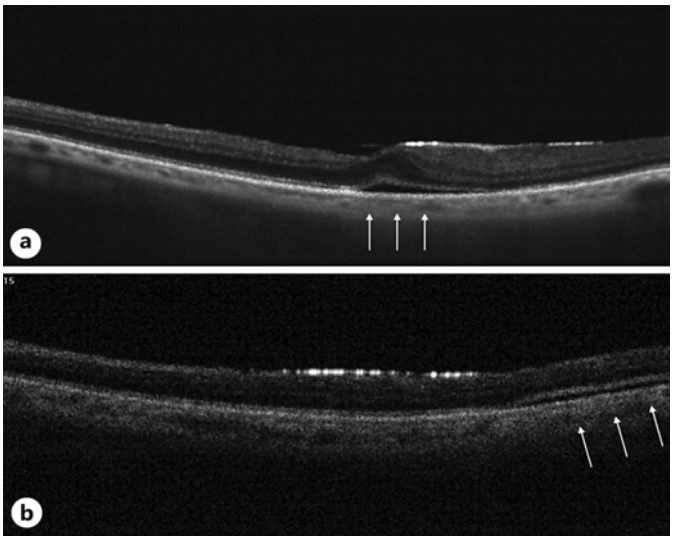

Fig. 1. a At 7 days post-op, SD-OCT shows a flattened macula with mild remnants of SRF (white arrows) subfovealy. **b** An additional separate shallow layer of SRF in the lower temporal site of the macular area can be seen.

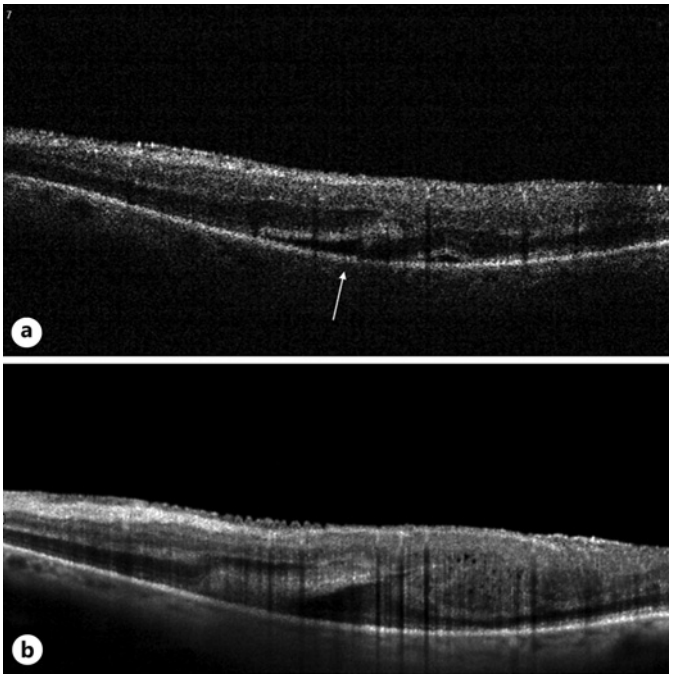

Fig. 2. Macular SD-OCT. **a** 6 weeks post-op. **b** 12 weeks post-op. Note the ill-defined retinal layers and the ERM formation.

[2] morphology and, of note, showed signs of aggravation over time. Additionally, RFs were observed in various topographic points of the macular region, not necessarily corresponding to the oblique line of the preexistent retinal detachment. The aggressive deterioration of the retina's architecture and the rapid decline of VA dictated the removal of SO at 3 months

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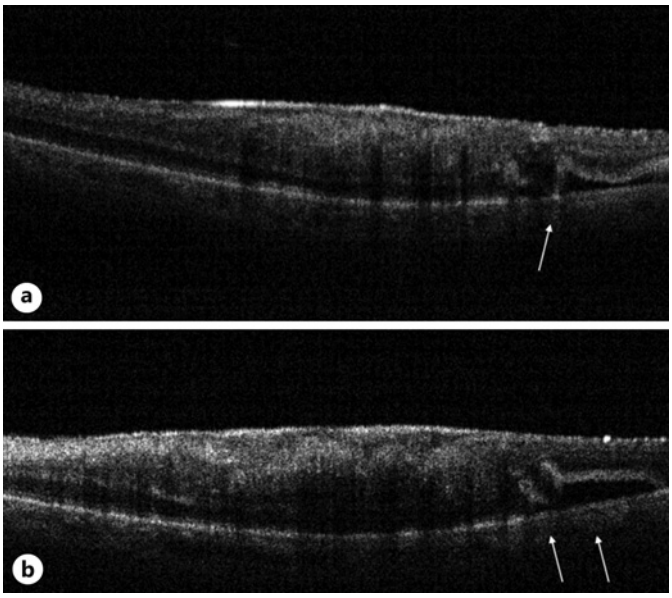

Fig. 3. SD-OCT of the same lower temporal site of the macula as shown in Fig. 1B. **a** 6 weeks post-op. **b** 12 weeks post-op. Note the formation of the RFs.

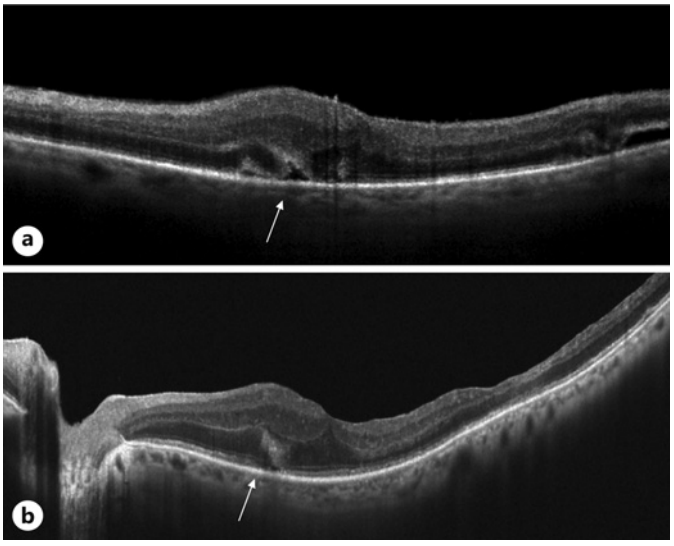

Fig. 4. Macular SD-OCT. **a** 1 week post-SO removal and (**b**) 1 month post-SO removal, showing the evolution of a "taco" ORF (white arrows).

following the primary repair combined with ERM and internal limiting membrane peeling. Despite the fact that the SO removal and ERM/internal limiting membrane peeling appeared beneficial for both VA and retinal layer architecture, there was only a mild positive effect on ORFs by withholding their aggravation without promoting their resolution. In fact, the combination of "taco" and "ripple" types persisted (Fig. 4, 5).

In OCT-angiography, a signal reduction is noted at the level of the choriocapillaries along the "taco" ORF and the SRF beneath it, presenting an improvement over a period of 5 months (Fig. 6, 7). The fundus image of the post-SO removal period depicts the lesions corresponding

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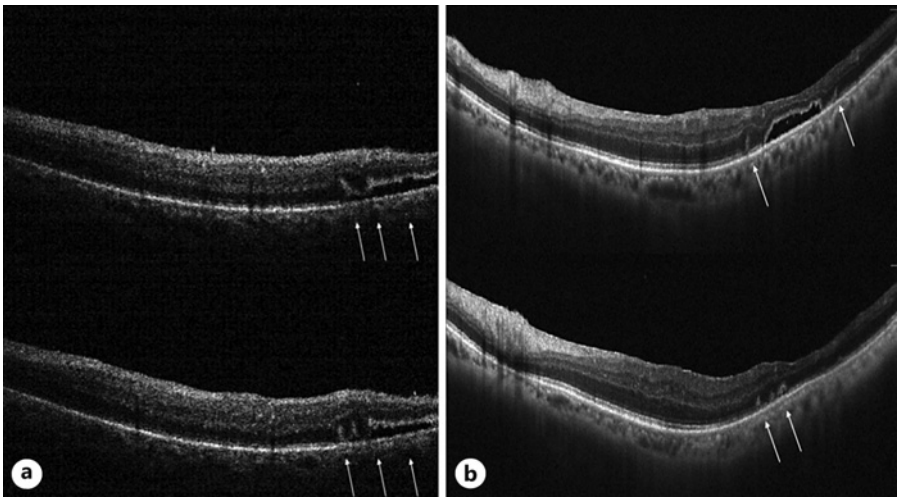

Fig. 5. SD-OCT of the same lower temporal site of the macula as shown in Figures 1B and 3. **a** 1 week post-SO removal and (**b**) 1 month later, showing a number of "ripple" ORFs (white arrows).

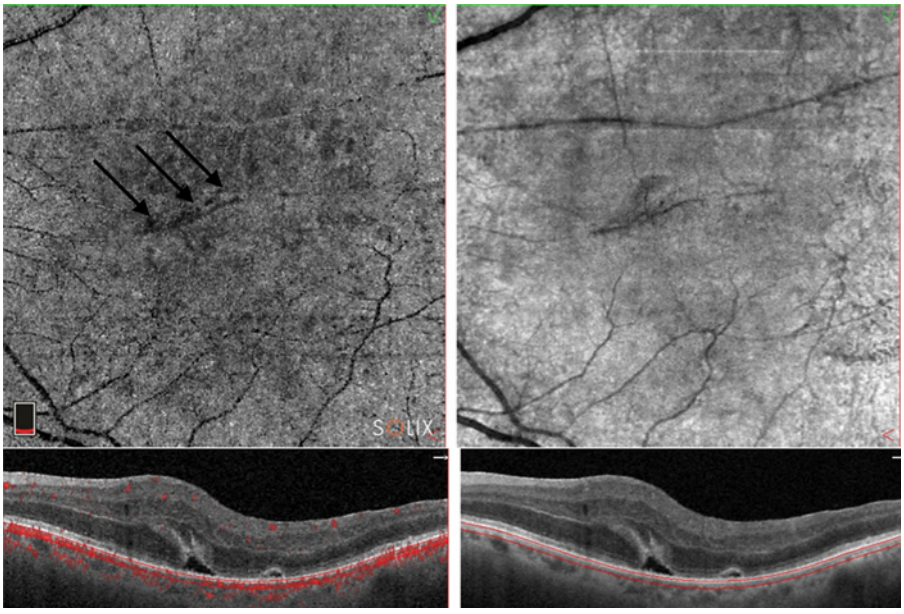

Fig. 6. OCT-A of the choriocapillaries layer presenting a signal reduction along the "taco" ORF and the SRF beneath it, 1 month post-SO removal.

to the ORFs (Fig. 8). We may observe that these lesions appear to be vertical to the RRD which, as mentioned above, extended superotemporally from 11th to 5th o'clock. That would be yet another point, along with the SD-OCT findings, to reveal that RFs may not have occurred in the immediate postoperative period.

Another site of SRF could be found superonasally to the macula, proximal to the superior temporal vascular arcade with more of the "ripple" type ORFs nearby (Fig. 9). The persistent pockets of SRF may have contributed to the RFs formation under the presence of SO or, alternatively, be associated with the remission of the folds and IS/OS changes. SD-OCT indicated a hypo-reflective gap between the IS/OS and the retinal pigment epithelium (Fig. 10).

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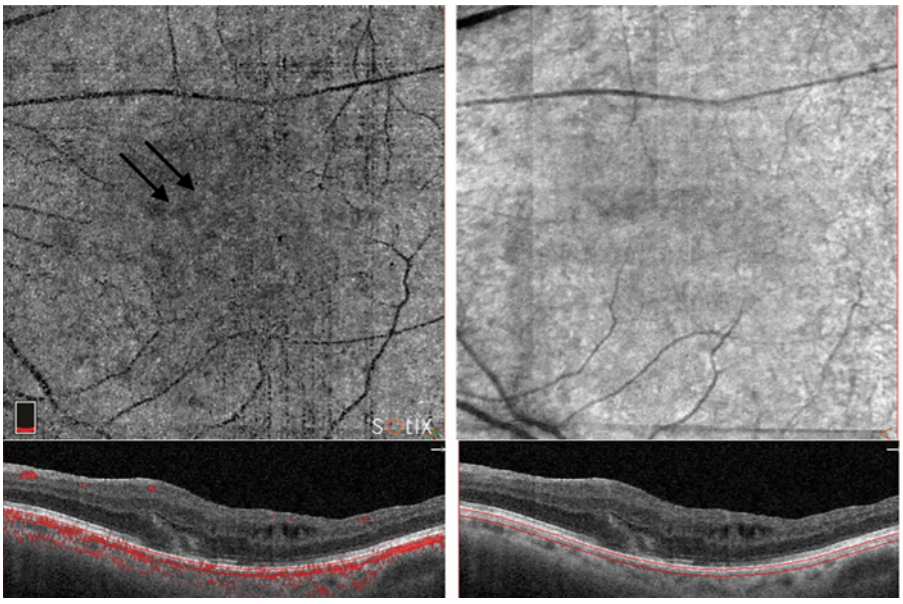

Fig. 7. OCT-A of the same area as the Fig. 6 with marked improvement of the signal reduction, 6 months post-SO removal.

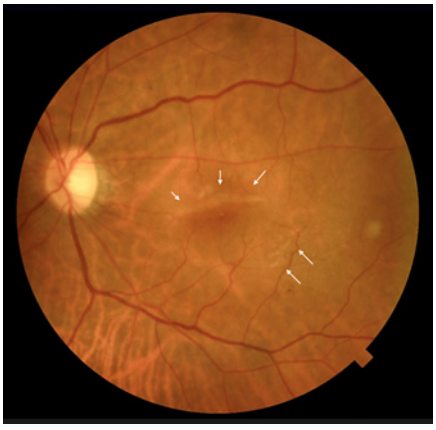

Fig. 8. Fundus image 1 month post-SO removal, with the white arrows pointing at the sites of the RFs.

In the long-term follow-up examinations in our case, the RFs have either partially settled down or disappeared (Fig. 4, 5, 10–14) without any intervention, leaving minor defects in the IS/OS. Such was identified for both the "taco" as well as the "ripple" type of ORFs.

Discussion

Given that our understanding of the cellular processes that occur in the detached retina derive mainly from experimental studies and limited histopathologic reports, the exact pathogenic mechanisms implicated in the development and evolution of RFs after RRD repair need to be further elucidated. Advanced retinal imaging has provided new insights in morphological changes of the retinal tissue that may not be obvious in fundoscopic examination and may be accountable for functional outcomes.

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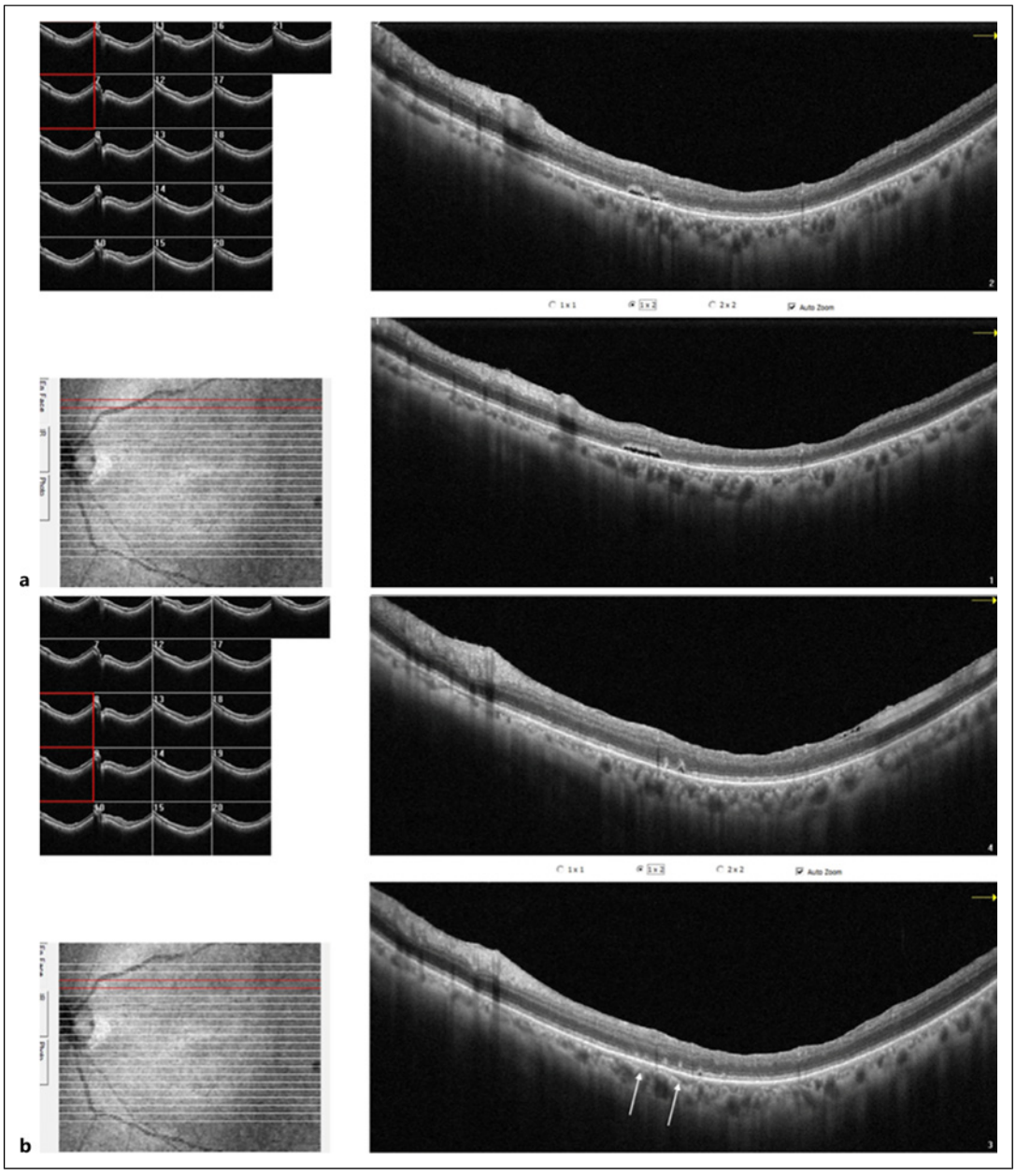

Fig. 9. SD-OCT of a superonasal to the macula site. **a** SRF. **b** ORFs.

The literature provides evidence of variable risk factors that lead to RFs formation. Admittedly, the mobile and elastic nature of the retina, along with the residual post-op SRF and head positioning may result in subsequent displacement of fluid, retinal shifting and folding in the early postoperative period [1, 3]. In theory, inner retinal undulations secondary to structural changes may also be related to the formation of subretinal fluid pockets, later evolving into ORFs, in presence of internal tamponade [3]. Indeed, if a relationship exists between pockets of SRF and ORFs, the intraocular tamponade could be a key element. Most studies have examined the characteristics of RFs under the use of intraocular gas and found that the RFs appeared in the immediate postoperative period and disappeared spontaneously.

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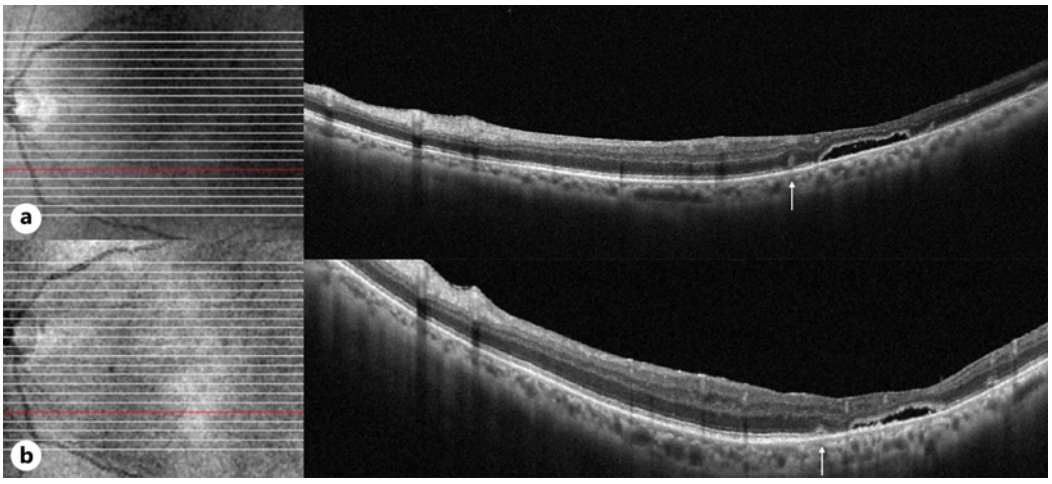

Fig. 10. a 1 month post-SO removal. **b** 4 months post-SO removal. Note the hypo-reflective spot beneath the IS/OS.

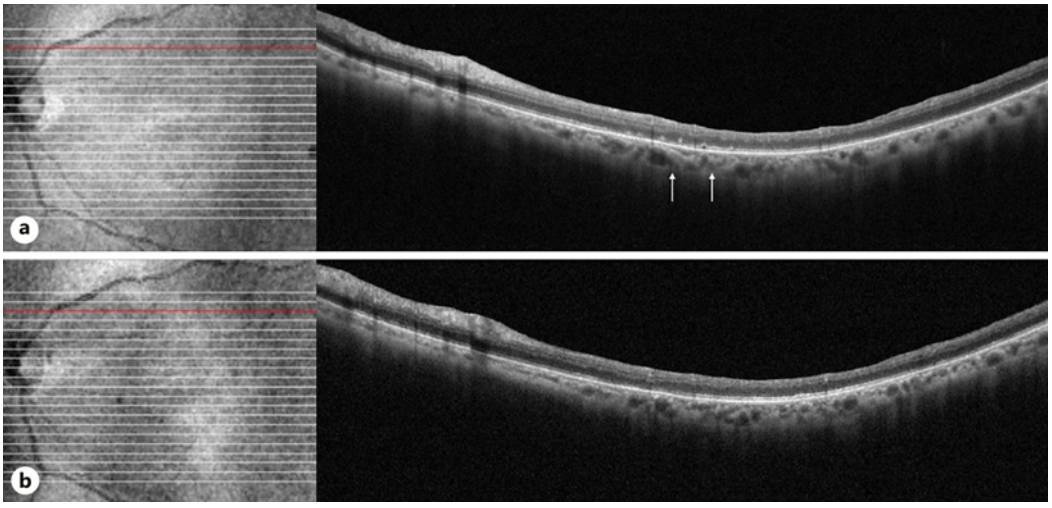

Fig. 11. a 1 month post-SO removal. **b** 4 months post-SO removal with a complete remission of the ORFs.

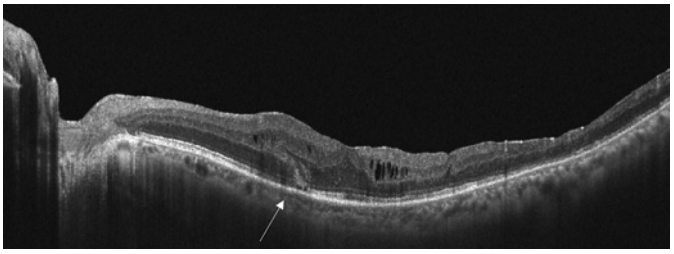

Fig. 12. SD-OCT of the macula at 4 months post-SO removal demonstrating the persistence of the "taco" type ORF.

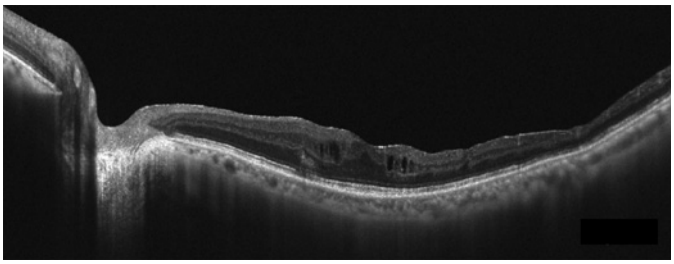

Fig. 13. SD-OCT of the macula at 12 months post-SO removal with the "taco" type ORF slightly improved.

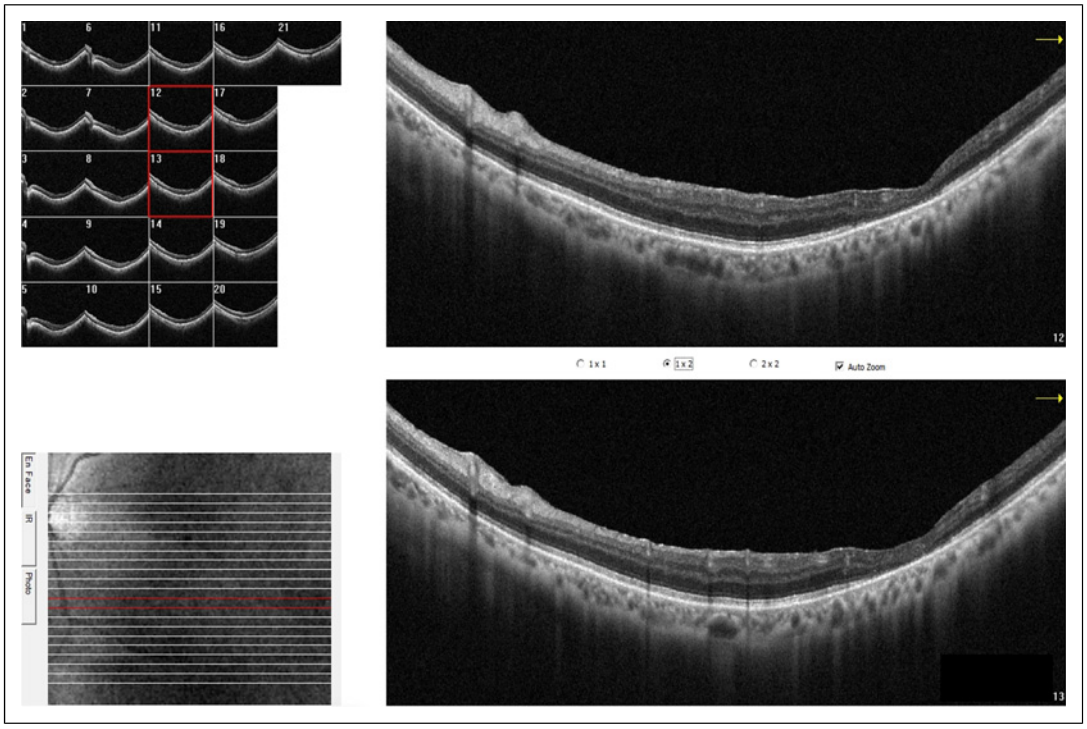

Fig. 14. SD-OCT of the same site as shown in Fig. 1b, 3, 5, and 10 at 12 months post-SO removal. Note the complete absence of the photoreceptor layer as well as the thinning of the neurosensory retina where the PSF was present.

Our case highlights the development of late-onset RFs under SO; thus, the underlying pathophysiology is intriguing. The formation of RFs occurred at almost 6 weeks post-vitrectomy; however, there were no predictive signs in the early postoperative period of this evolution. In fact, the residual subretinal fluid was not of significant amount and the patient reported to have strictly followed the instructions of head posturing. The case presented herein differs since the RFs that developed in the very late postoperative period under SO showed aggravation instead of improvement. Furthermore, development of ERM that alters the structure and elasticity of the retina could be another factor favoring the formation of the ORFs, although it has been reported that presence of ERM does not prevent or slow down their resolution and has an overall negligible effect [3]. On the contrary, in our case, the removal of ERM had a mild but beneficial effect on the regression of RFs. The explanation of this discrepancy might be the different degree of traction that an ERM exerts on the retinal surface under the presence of gas or SO tamponade, respectively.

It is a hypothesis that based on the time of appearance and aggravated course of the RFs, other parameters should have played a definitive role in their development and progression. One explanation of the rapidly grown disorganization of the retinal layers after vitrectomy may involve postoperative inflammation along with presumed low-grade SO toxicity that could act as a stimulus for RFs and ERM formation. Inevitably, a further support of this theory is that the retinal layer architecture considerably improved after the removal of SO and peeling of ERM. Indeed, the superficial tension induced by the ERM and the thickening of the retinal layers may have played a role in the formation of RFs. In addition, our case notably demonstrates areas devoid of capillaries in the choriocapillaris plexus as seen on OCT-A, coinciding with the areas of RFs on OCT; interestingly, these areas present a gradual improvement after SO removal over time. Whether these areas represent ischemia of the choriocapillaris or shadowing artifacts corresponding to the RFs consists a matter of further study. Overall, in our case it could be hypothesized that the formation of ERM under intravitreal SO tamponade altered the physiologic elasticity of the retina leading to formation and aggravated course of the RFs in the presence of mild subretinal fluid. Lastly, the presence of pockets of SRF has been described in literature as a possible cause of RFs [4] which is likely in this patient due to the proximity of the RFs to sites of SRF pockets. A combination of all the aforementioned factors has led to the appearance of the ORFs.

In conclusion, our case affords insights into pathological processes that may be associated with the development and evolution of RFs after successful RRD repair. It is critical to accurately diagnose the type of RFs, closely monitor progression and provide prognostication for future visual outcomes. Our aim was to raise awareness that a combination of various types of RFs along with retinal disorganization may appear in the late postoperative period after RRD repair with SO tamponade and clinicians may need to plan the follow-up accordingly. Further research is needed with regard to the mechanism of retinal remodeling and folds pathogenesis eventually leading to appropriate management. The CARE Checklist has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see https://doi.org/10.1159/000538501).

Statement of Ethics

Ethical approval is not required for this case report in accordance with local or national guidelines. Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Conflict of Interest Statement

The authors report that they do not have any conflict of interest regarding the presenting data.

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Author Contributions

Ioannis Iatropoulos contributed to writing, design, interpretation, and final approval of the manuscript and is accountable for accuracy and integrity of the work. Evita Evangelia Christou contributed to writing, interpretation, drafting, and final approval of the manuscript and is accountable for accuracy and integrity of the work. Efthymios Karmiris, Ioanna Chranioti, Konstantinos Kounas, and Vasileios Kozobolis contributed to interpretation, drafting, and final approval of the manuscript and are accountable for accuracy and integrity of the work. Panagiotis Stavrakas contributed to design, interpretation, drafting, and final approval of the manuscript and is accountable for accuracy and integrity of the work.

Data Availability Statement

All data generated or analyzed during this study are included in this article and its online supplementary material files. Further inquiries can be directed to the corresponding author.

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