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Case Report

A Case of Closure of Recurrent Full-Thickness Macular Hole by Spontaneous Retinal Detachment around the Macular Hole and Gas Tamponade

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Keywords
Recurrent macular hole · Gas tamponade · Retinal detachment · Case report

Abstract
Introduction: Here, we present a case of full-thickness macular hole (FTMH) recurrence following two vitrectomies, accompanied by additional internal limiting membrane (ILM) peeling and gas tamponade. Ultimately, FTMH closure was accomplished by spontaneous retinal detachment around the macular hole and gas tamponade alone. ***Case Presentation:*** The patient, a 54-year-old woman with a lamellar macular hole, had a visual acuity of 20/100 in her left eye. The treatment regimen included cataract surgery, a 25-gauge pars plana vitrectomy involving ILM peeling, application of the lamellar hole epiretinal proliferation embedding technique, and subsequent gas tamponade. Closure of the lamellar macular hole was observed a month post-surgery, improving visual acuity to 20/40. However, FTMH developed 3 months after the initial surgery, resulting in visual acuity decline to 20/100. A 25-gauge pars plana vitrectomy was performed with extensive ILM peeling and 20% sulfur hexafluoride gas tamponade. FTMH closure was noted within 19 days after reoperation, enhancing visual acuity to 20/66. Approximately 1.5 months after reoperation, a pinhole-shaped macular hole was identified, and the patient opted for follow-up observation due to her refusal to undergo additional surgery. As the macular hole gradually enlarged resembling retinal detachment, outpatient fluid-gas exchange with 14% perfluoropropane was performed

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3.5 months after reoperation. The FTMH closed within a week post-gas injection and remained closed for more than 1 year. Consequently, visual acuity in the left eye was sustained at 20/50. ***Conclusion:*** We encountered a case that might highlight the significance of releasing subretinal adhesions surrounding a FTMH for successful closure.

Introduction

The pathology of full-thickness macular holes (FTMHs) has been extensively studied, and both vertical and horizontal traction by the vitreous and epiretinal membranes have been recognized as contributing factors [1–3]. Kelly and Wendel [4] pioneered the treatment of FTMH using pars plana vitrectomy and gas tamponade. This approach has evolved into the current standard for removing vitreous traction, addressing the epiretinal membranes and the inner limiting membrane (ILM), followed by gas tamponade. Although the reported closure rate of FTMH exceeds 95% [5], refractory cases persist. These cases have prompted attempts at additional interventions, such as extensive ILM peeling [6], inverted ILM flaps [7], autologous neurosensory retinal-free flap application [8], outpatient fluid-gas exchange (FGX) [9], and autologous platelet concentrates [10]. Notably, some study suggested that firm adhesion between photoreceptors and the retinal pigment epithelium hinders FTMH closure, leading to subretinal adhesion release using subretinal fluid applications [11, 12]. Herein, we present a case that might underscore the importance of releasing subretinal adhesions to achieve FTMH closure. Our report details a case of recurrent FTMH after vitrectomy with additional ILM peeling and gas tamponade, which ultimately achieved FTMH closure through spontaneous retinal detachment around the macular hole and gas tamponade alone.

Case Presentation

A 54-year-old woman presented with distorted vision in her left eye and was diagnosed with a lamellar macular hole (LMH) (Fig. 1a, b). Her left visual acuity was 20/100 and her left intraocular pressure was 18 mm Hg. Surgical interventions included cataract surgery, 25-gauge pars plana vitrectomy with ILM peeling (Fig. 1c), lamellar hole epiretinal proliferation embedding technique, and air tamponade, with the patient maintaining a prone position for 3 days (Intervention 1). The LMH closed within a month, and visual acuity improved to 20/40 (Fig. 1d, e). However, FTMH developed in her left eye 3 months after surgery, with visual acuity declining to 20/100 (Fig. 1g, h). Subsequent vitrectomy involving extensive ILM peeling (Fig. 1f) and 20% sulfur hexafluoride (SF6) tamponade, with the patient maintaining a prone position for at least 3 days (intervention 2), achieved closure of the FTMH within 19 days, resulting in a visual acuity of 20/66 (Fig. 1i, j). A pinhole-shaped FTMH appeared 1.5 months later (Fig. 2a, b), prompting follow-up owing to the patient's refusal to undergo additional surgery. Gradual FTMH enlargement resembling retinal detachment (Fig. 2c, d) with visual acuity declining to 20/125, outpatient FGX with 14% perfluoropropane (C3F8) was performed 3.5 months after reoperation, and the patient maintained a prone position for at least 3 days (Intervention 3). FTMH closure was achieved within a week post-gas injection, which was maintained for over a year with visual acuity reaching 20/50

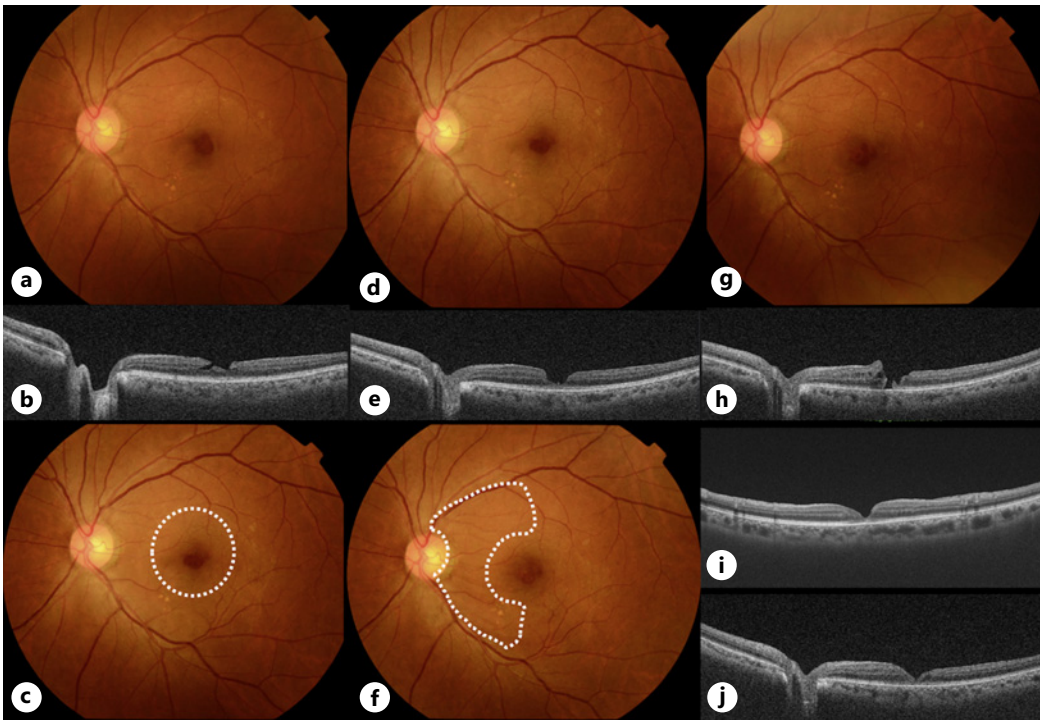

Fig. 1. Funduscopic examination and optical coherence tomography (OCT) findings at the initial visit and before/after LMH and FTMH surgery, and the area of ILM peeling during initial and reoperation. **a**, **b** Fundoscopic examination and OCT at the initial visit revealed the presence of a lamellar macular hole (LMH) and a thin epiretinal membrane. One month after the initial operation, a follow-up fundoscopic examination and OCT showed that the LMH had closed (**e**) and the epiretinal membrane was successfully removed (**d**). Three months after the initial procedure, the full-thickness macular hole (FTMH) was not clearly visible in the fundus (**g**) but was observed on the OCT scan (**h**). Area of ILM peeling at initial operation (**c**) and reoperation (**f**). Tractions from the nasal side of the FTMH were seen (**h**), and additional ILM peeling was performed on the nasal side (**f**). OCT showed that the FTMH had closed (**i**, **j**) 3 weeks after reoperation.

(Fig. 2e, f). 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/10.1159/000536338).

Discussion

Addressing the repair of recurrent FTMH involves interventions [6] such as additional ILM peeling, subretinal fluid injection, autologous platelet plasma injection, material transplantation, and outpatient FGX. Typically, multiple procedures are combined to increase the likelihood of recurrent FTMH closure; however, the crucial factor for effective FTMH closure remains uncertain.

Here, we presented a case which might demonstrate the importance of releasing subretinal adhesions around a FTMH to achieve closure. We summarize intervention 2 and 3 (Fig. 3).

When the FTMH was occurred after intervention 1 (Fig. 3a), the vitrectomy with ILM peeling had been performed. Gas tamponade alone could treat the FTMH because the condition remained the same after FTMH surgery, the size of FTMH was small, and there are

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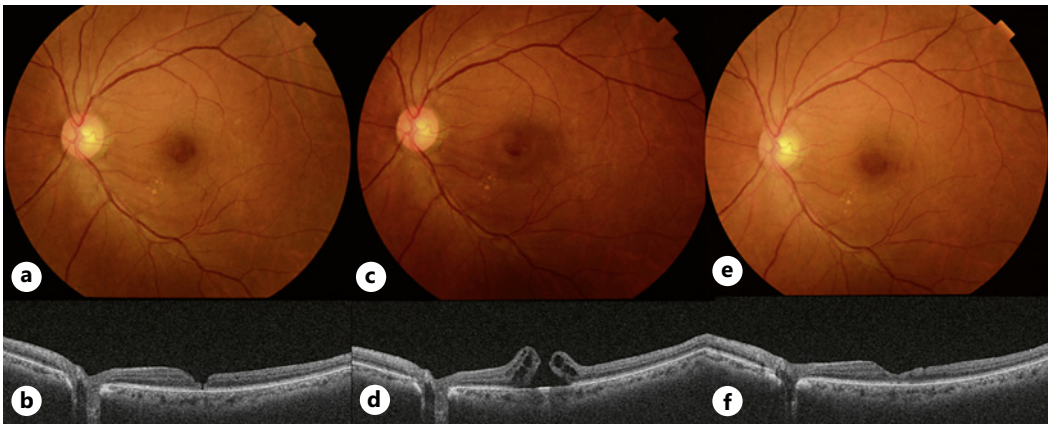

Fig. 2. Funduscopic examination and OCT findings before/after gas tamponade alone. One and a half months after reoperation, the pinhole FTMH is not clearly visible in the fundus (**a**), but is observed on OCT (**b**). 3.5 months after reoperation, the FTMH was visible in the fundus (**c**), and FTMH enlargement resembling retinal detachment was observed on OCT (**d**). More than 1 year after gas injection, the full-thickness macular hole (FTMH) had been closed (**e**, **f**).

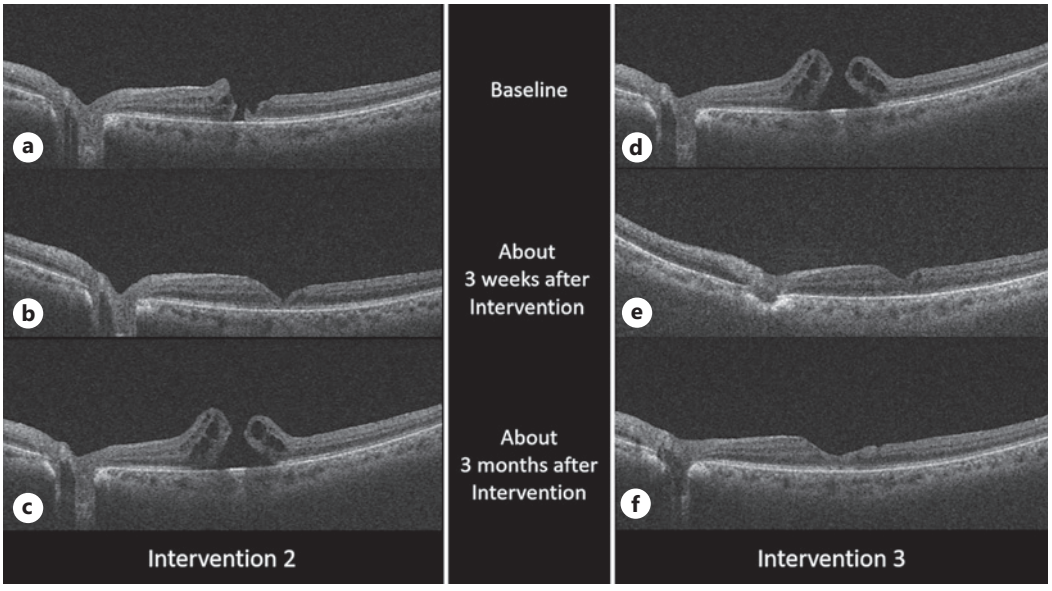

Fig. 3. Comparison of OCT findings between intervention 2 and 3. A smaller FTMH (**a**) and a larger FTMH with retinal detachment around the macular hole (**d**) were observed on OCT at the baseline. The FTMH was closed (**b**) about 3 weeks after extensive ILM peeling and 20% SF6 Gas tamponade (Intervention 2). The FTMH was closed (**e**) about 3 weeks after outpatient FGX with 14% C3F8 alone (intervention 3). Recurrence of FTMH was observed (**c**) about 3 months after intervention 2 and FTMH kept closing (**f**) about 3 months after intervention 3.

some reports indicating that gas tamponade alone can successfully treat the FTMH [9, 13]. However, we performed extensive ILM peeling and 20% SF6 tamponade (intervention 2) to ensure the closure of the FTMH. The FTMH was closed 3 weeks after intervention 2 (Fig. 3b). Unfortunately, FTMH reoccurred 1.5 months after reoperation (Fig. 2b) and enlarged with spontaneous retinal detachment around FTMH 3.5 months after operation (Fig. 3c). In terms

of the size of FTMH, the condition of FTMH at the baseline of Intervention 3 appeared to worsen when compared to intervention 2 and 3 (Fig. 3a, d). However, outpatient FGX with 14% C3F8 alone (intervention 3) could close the recurrent FTMH within a week. The FTMH closed within a week and remained closed 3 weeks, 3 months (Fig. 3e, f), and more than 1 year (Fig. 2f) after outpatient FGX. The differences between intervention 2 and intervention 3 were the type of gases used for tamponade and the amount of subretinal adhesions around the FTMH at the baseline.

In intervention 2, the vitreous cavity was fully exchanged with 20% SF6 in the operating room, while in intervention 3, 70% of the vitreous cavity was exchanged with 14% C3F8 in an outpatient examination room due to the patient's nervousness and the difficulty of additional FGX. It took 10 days in intervention 2 and 20 days in Intervention 3 for the gas level in the vitreous cavity to drop below 50%. While these differences might have influenced the closure of the recurrent FTMH, in our case, the recurrent FTMH closed within a week. Previous studies have shown a comparable anatomical success rate between SF6, C2F6, and silicone oil for persistent idiopathic FTMH with tamponade alone [13]. Hence, we hypothesize that the detachment of the retina around the FTMH, which essentially involves releasing subretinal adhesions, contributes to facilitating FTMH closure [11, 12]. According to a report [14], recurrent FTMH with an elevated edge tends to result in FTMH closure. An elevated edge often signifies the release of subretinal adhesions.

Previous study [13], which examined 74 eyes of 74 patients with persistent macular holes, found that revision surgery for persistent idiopathic FTMH using tamponade alone achieved a comparable anatomical closure rate to tamponade with adjuvant manipulation. This surprisingly high success rate of tamponade alone may be attributed to the possibility that, like in our case, these patients might have had spontaneous retinal detachment around the FTMH. This is suggested by the presence of detachment around the macular hole in their data.

Our patient showed spontaneous retinal detachment around the FTMH (Fig. 3c) 3.5 months after intervention 2. There are two potential underlying pathologies for this phenomenon: residual tangential traction and the development of FTMH after LMH. A previous study [15] reported FTMH following LMH surgery, which displayed spontaneous retinal detachment around the FTMH. Although the mechanism underlying spontaneous retinal detachment in relation to FTMH remains unclear, it is plausible that this condition, along with tangential traction, contributes to such occurrences.

Prospective randomized controlled studies are required to conclusively identify the essential factors for recurrent FTMH closure. However, in our case, recurrent FTMH closure was achieved through spontaneous retinal detachment around the macular hole and gas tamponade alone. This closure persisted for over a year, despite the presence of residual tangential traction. Consequently, our case may underscore the importance of releasing subretinal adhesions around recurrent FTMH to facilitate closure and this phenomenon helps closed FTMH by gas tamponade alone.

Conclusion

We encountered a case that might highlight the significance of releasing subretinal adhesions surrounding a FTMH for successful closure.

Acknowledgments

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Statement of Ethics

This research complied with the guidelines for human studies and was conducted ethically following the World Medical Association Declaration of Helsinki. Written informed consent was obtained from the patient for the publication of this case report and the accompanying images. The study was exempted from ethics approval by the Institutional Review Board/Ethics Committee. Ethical approval was not required for this study in accordance with the national guidelines.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Kentaro Nishida, Tatsuya Yagura, and Sakaguchi Hirokazu participated in drafting the manuscript. Kentaro Nishida and Sakaguchi Hirokazu participated in patient diagnosis and treatment. Kentaro Nishida, Tatsuya Yagura, Sakaguchi Hirokazu, and Kohji Nishida have read and approved the final version of the manuscript.

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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