

Case Report

## Embedding of Epiretinal Proliferation for a Secondary Lamellar Macular Hole 12 Years after Rhegmatogenous Retinal Detachment Repair

Miyuki Fujiwara, Shuhei Kimura, Mio Morizane Hosokawa, Yusuke Shiode,  
Shinichiro Doi, Kosuke Takahashi, Ryo Matoba, Yuki Kanzaki,  
and Yuki Morizane\*

Department of Ophthalmology, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences,  
Okayama 700-8558, Japan

A 58-year-old Japanese man underwent vitrectomy for rhegmatogenous retinal detachment (RRD) in 2002. Twelve years later, optical coherence tomography revealed the development of a lamellar macular hole; the visual acuity was 20/200. Two years later, because metamorphopsia and the foveal retina thinning were aggravated, epiretinal proliferation embedding was performed to restore the foveal structure by transplanting glial cells to the foveal cavity. The patient was followed-up for 4 years, and his macular morphology and visual acuity (20/66) improved. No complications occurred. This appears to be the first report of epiretinal proliferation embedding for a lamellar macular hole post-RRD repair.

**Key words:** lamellar macular hole, epiretinal proliferation, rhegmatogenous retinal detachment, vitrectomy

The retinal pathology known as a lamellar macular hole was first reported as a macular disorder presenting with foveal irregularities similar to those observed with a full-thickness macular hole, based on biomicroscopy observations [1]. The pathophysiology of lamellar macular holes is still largely unknown. With the advent of high-resolution optical coherence tomography (OCT), the macular morphology of lamellar macular holes has been characterized in detail, and in recent years, 'lamellar macular hole' has been defined as a disorder presenting with the following characteristic OCT findings: the presence of an irregular foveal contour, the presence of a foveal cavity with undermined edges, and an apparent loss of foveal tissue [2].

A lamellar macular hole has been reported to develop secondarily to various conditions such as macular edema, full-thickness macular hole formation, and retinoschisis with high myopia [1, 3-9]. Xirou *et al.* also reported

lamellar macular hole as a rare complication of rhegmatogenous retinal detachment (RRD) [10]. However, the pathogenesis of lamellar macular hole associated with RRD is unknown. Our research group has recently focused on the finding that the epiretinal proliferation associated with lamellar macular holes is composed mainly of glial cells [11], and we reported a surgical technique for the embedding of the epiretinal proliferation into the foveal cavity of a lamellar macular hole [12-14].

This procedure resulted in a significant improvement in patients' macular morphology and visual acuity, and the therapeutic effect was maintained over a long term (average 30 months) [14]. However, to our knowledge, there is no report of the embedding of epiretinal proliferation for a lamellar macular hole associated with RRD. Here we describe the 4-year follow-up findings for a 58-year-old man who successfully under-

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\*Corresponding author. Phone: +81-86-235-7297; Fax: +81-86-222-5059  
E-mail: moriza-y@okayama-u.ac.jp (Y. Morizane)

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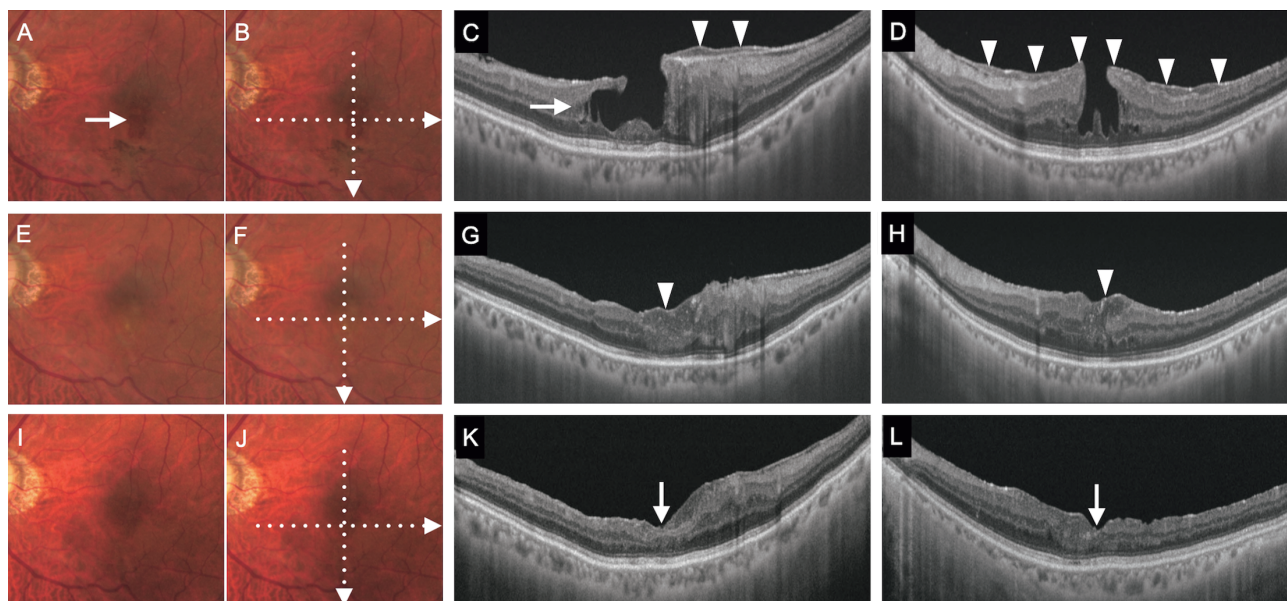
went the embedding of epiretinal proliferation for a lamellar macular hole that developed after the repair of his RRD.

### Case Report

A 58-year-old Japanese man visited our hospital with decreased vision in his left eye in April 2002. At his initial visit, there was no history of systemic or ophthalmological disease. The best-corrected visual acuity (BCVA) was 20/16 and 20/666 for the right and left eyes, respectively. The axial lengths of the right and left eyes were 25.07 and 24.87 mm, respectively. No abnormalities were detected in the right eye. Total retinal detachment was observed in the left eye, with a peripheral retinal tear. The patient underwent phacoemulsification and aspiration, an intraocular lens implantation, a 20-gauge vitrectomy, encircling, 20% sulfur hexafluoride gas tamponade, and endophotocoagulation. After the surgery, the retina was attached.

In April 2014, at the patient's regular postoperative visit, OCT (DRI OCT-1 Atlantis, Topcon, Tokyo) showed a lamellar macular hole at the fovea of the left eye, and his visual acuity was 20/200. Thereafter, the foveal cavity gradually increased, and in June 2016, metamorphopsia and thinning of the foveal retina [central retinal thickness of 158  $\mu\text{m}$ ] were aggravated and epiretinal proliferation was increased (Fig. 1A-D), even though the patient's visual acuity remained unchanged. OCT en face images showed mild retinal folds with a maximum depth of retinal folds [15,16] of 13  $\mu\text{m}$  (Fig. 2A).

After obtaining written consent from the patient, we performed a 25-gauge transconjunctival, microincision vitrectomy with embedding of the epiretinal proliferation, internal limiting membrane (ILM) peeling, and air tamponade as we have described [12]. Briefly, epiretinal proliferation was centripetally peeled off from the retina using microforceps, and it was left attached to the edge of the lamellar macular hole (Fig. 3). Next,



**Fig. 1** Images acquired before (A-D), 1 month after (E-H), and 4 years after (I-L) the embedding of the epiretinal proliferation in the present patient's case of a lamellar macular hole that formed after rhegmatogenous retinal detachment (RRD) repair. Fourteen years after the RRD repair, a color fundus photograph (A) shows a macular hole (MH)-like lesion (*arrow*). B-scan images (C,D) show the lamellar macular hole with a foveal cavity (*arrow* in C) and epiretinal proliferation (*arrowheads* in C,D). The visual acuity was 20/200, and the central retinal thickness was 158  $\mu\text{m}$ . At 1 month after the epiretinal proliferation embedding, the MH-like lesion had disappeared (E). B-scan images (G,H) show the epiretinal proliferation embedded in the foveal cavity (*arrowheads*). The visual acuity was 20/200, and the central retinal thickness was 296  $\mu\text{m}$ . Four years after the epiretinal proliferation embedding, the volume of the embedded epiretinal proliferation had reduced (*arrows* in K,L). No MH or epiretinal membrane was observed. The visual acuity improved to 20/66, and the central retinal thickness was 190  $\mu\text{m}$ . The *dotted arrows* in B, F, and J indicate the scan location and the direction of the B-scan images (C, G, K are vertical scan images; D, H, L are horizontal scan images).

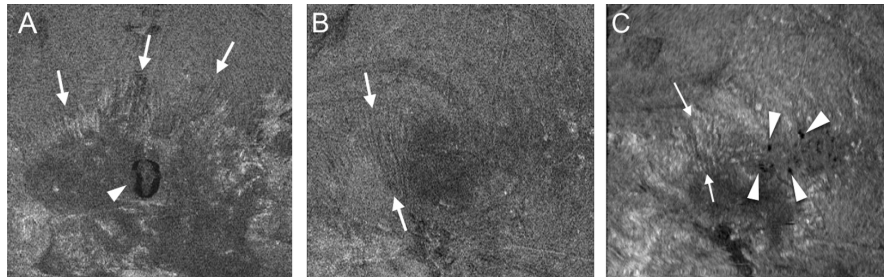
brilliant blue-assisted ILM peeling (Coomassie brilliant blue G250 solution, Sigma-Aldrich, St. Louis, MO, USA) was performed around the lamellar macular hole in a circumferential manner. The epiretinal proliferation was gently massaged centripetally over the lamellar macular hole so that it was embedded into the foveal cavity of the lamellar macular hole. Because the epiretinal proliferation was larger than the lamellar macular hole area, it was trimmed to fit the size of the foveal cavity.

Fluid-air exchange was performed at the end of the surgery, after which the patient maintained a face-down position for 24 h. At 1 month after the surgery, his visual acuity remained unchanged (20/200), and the foveal cavity appeared to be filled with the embedded epiretinal proliferation on OCT images (Fig. 1E-H, Fig. 2B). Four years after the surgery, the eye's central retinal thickness was 190  $\mu\text{m}$ , and we found improvements in

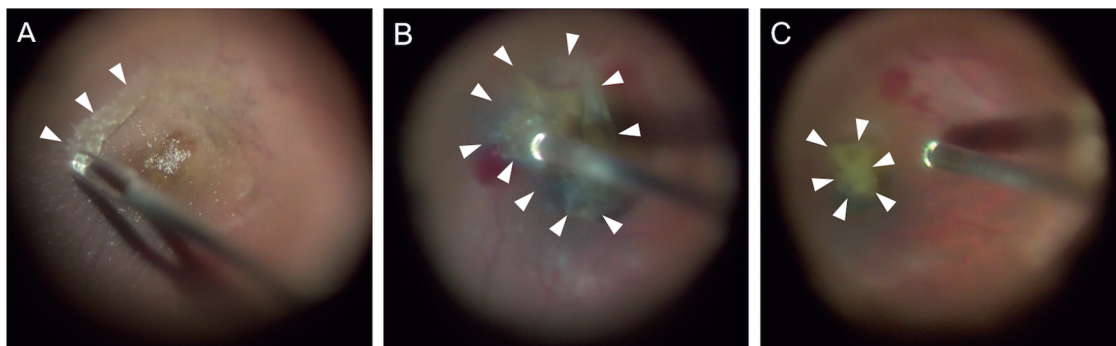
both the visual acuity (20/66) and macular morphology. There were no postoperative complications such as macular thinning, full-thickness macular hole formation, or epiretinal membrane formation (Fig. 1I-L, Fig. 2C).

## Discussion

This case highlights the successful use of the embedding of epiretinal proliferation for the management of a lamellar macular hole that developed after a RRD repair. The patient was followed up for 4 years after the embedding of the epiretinal proliferation, and improvements were observed in both his visual acuity and macular morphology. Moreover, there were no complications such as macular thinning, full-thickness macular hole formation, or epiretinal membrane formation. Lamellar macular holes have been reported to develop second-



**Fig. 2** Pre- and postoperative changes in the retinal surface, visualized using en face imaging, in the patient's lamellar macular hole that was treated by the embedding of the epiretinal proliferation. **A**, A preoperative en face image reveals the foveal cavity in the region corresponding to the lamellar macular hole (*arrowhead*). Mild retinal folds are observed (*arrows*), with a maximum depth of the retinal folds of 13  $\mu\text{m}$ ; **B**, One month after the epiretinal proliferation was embedded, the foveal cavity had disappeared and the number of retinal folds had decreased (*arrows*); **C**, The foveal cavity cannot be seen 4 years after the embedding of the epiretinal proliferation. A slightly dissociated optic nerve fiber layer was observed (*arrowheads*), although there was no macular hole or epiretinal membrane formation.



**Fig. 3** Intraoperative photos of the embedding of epiretinal proliferation in the patient's lamellar macular hole that formed after RRD repair. **A**, The epiretinal proliferation (*arrowheads*) was centripetally peeled off from the retina using microforceps, and it is left attached to the edge of lamellar macular hole; **B**, After internal limiting membrane peeling, the epiretinal proliferation (*arrowheads*) was gently massaged centripetally over the lamellar macular hole; **C**, The epiretinal proliferation (*arrowheads*) was trimmed to fit the size of the foveal cavity of the lamellar macular hole and subsequently embedded into the cavity.

arily to conditions such as macular edema, full-thickness macular hole formation, and retinoschisis with high myopia [1,3,5-9,17]. Although a lamellar macular hole has also been reported to develop after RRD repair, it is considered rare with an incidence of 0.5% [10]. To our knowledge, this is the first report of the embedding of the epiretinal proliferation for a lamellar macular hole that formed after RRD repair.

In our patient's case, the lamellar macular hole was diagnosed based on the criteria proposed by Hubschman *et al.*: the presence of an irregular foveal contour, the presence of a foveal cavity with undermined edges, and an apparent loss of foveal tissue [2]. These criteria clearly delineate the morphological features of lamellar macular holes; however, the pathogenesis of lamellar macular holes remains unclear.

We recently analyzed en face images of a lamellar macular hole using swept-source OCT and observed that the epiretinal proliferation associated with the lamellar macular hole exerts little traction force on the retina; this suggests that retinal traction may not be involved in the pathogenesis of lamellar macular holes [15]. Those results were in contrast to those for epiretinal membrane foveoschisis and macular pseudohole, which show a macular morphology similar to that seen with lamellar macular holes, as en face images for the latter conditions indicated the involvement of retinal traction in their pathogenesis. In the present case, as shown in Fig.2A, the en face image showed retinal folds, which indicates the presence of tractional force on the retina [15,16].

Considering that our patient's lamellar macular hole developed after the repair of RRD, it is possible that the epiretinal proliferation observed in his case had the characteristics of a secondary epiretinal membrane, which is relatively common in cases of RRD, and that epiretinal proliferation itself exerted traction on the retina. However, the maximum depth of the retinal folds was 13  $\mu\text{m}$ , which means that the traction force exerted by epiretinal proliferation on the retina was much smaller than that observed in epiretinal membrane foveoschisis and macular pseudohole, which are associated with an average maximum depth of retinal folds of approx. 60  $\mu\text{m}$  [15]. Therefore, the involvement of retinal traction in the pathogenesis of the lamellar macular hole in our patient's case seems to be partial, at most. One of the possible causes of the formation of a lamellar macular hole is moderate myopia

[18]. Further investigation is needed to determine the pathogenesis of lamellar macular holes after RRD repair.

Different surgical treatments for lamellar macular holes have been proposed and can be classified into two types: removal of the epiretinal proliferation, and embedding of the epiretinal proliferation into the foveal cavity [8,9,11-14,19,20]. With epiretinal proliferation removal, there is poor postoperative improvement in the visual acuity, and the procedure is reportedly associated with the development of postoperative complications such as macular thinning and full-thickness macular hole formation [8,9,11]. With the embedding of the epiretinal proliferation, which is designed to restore the conformation of the fovea by transplanting glial cells into the foveal cavity, significant improvements in the postoperative visual acuity, central retinal thickness, and the outer retinal structure have been reported [12,13].

We recently examined the long-term outcomes of the embedding of epiretinal proliferation (average follow-up of 30 months) and observed that the procedure improved the visual acuity and macular morphology, with maintenance of the therapeutic effect over the long term without complications such as macular thinning, full-thickness macular hole formation, and epiretinal membrane formation [14]. These results are in good accordance with those of our present patient, whose visual acuity and macular morphology showed improvements even at 4 years after the surgery. No complications were observed.

This case report has 3 limitations: (1) the findings are based on only one case. (2) OCT observations were not performed for 12 years after the RRD repair; therefore, details regarding the lamellar macular hole formation process remain unclear. (3) Although we followed the patient for 4 years after the epiretinal proliferation embedding, the outcomes in the longer term remain unknown. It is necessary to continue the follow-up to investigate the development of complications, including the formation of a full-thickness macular hole and an epiretinal membrane, and the recurrence of the lamellar macular hole and epiretinal proliferation.

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