

Case Report

ILM Flap Repositioning for Persistent Macular Hole

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Keywords

Inverted flap · Persistent macular hole · Reoperation · Repositioning · Vitrectomy

Abstract

We present a case of a persistent macular hole which was initially treated by pars plana vitrectomy with the inverted ILM flap technique. In a second procedure, the internal limiting membrane (ILM) flap was mobilized from its perifoveal adherence to the retina and peeled back to its adherence at the foveal ring. The eye was filled with 25% C2F6 gas. Three weeks after the second procedure, closure of the hole was observed. Best corrected visual acuity increased from 20/400 to 20/50. We assume that contractile elements within the ILM may cause perifoveal adhesion and centrifugal effects preventing macular hole closure. If macular hole closure does not occur after surgery with an inverted ILM flap, it is worth to peel back the existing flap again towards the foveal edge in order to induce hole closure and preserve the benefits of flap surgery. If the flap is only attached to the foveal ring, centripetal contraction could lead to annular closure of the macular hole. If the flap is lost, alternative surgical methods for refractory MHs should be considered.

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Introduction

In 2008, Michalewska et al. [1] presented the inverted flap technique as an option in macular hole surgery: perifoveal internal limiting membrane (ILM) is mobilized and placed inverted in the hole area keeping it attached to the foveal rim. The method has been successfully used for large macular holes [2, 3] and macular holes with high myopia [4, 5]. It seems to have gained significant attention among vitreoretinal surgeons in recent years and has also been used successfully in macular holes <400 µm with high closure rates [6–8]. We wanted

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to explore the question of how a persistent macular hole after vitrectomy with the inverted flap technique can be closed and to what extent this might partly explain the closure mechanism.

Case Report

The patient was a 63-year-old lady with a full-thickness macular hole and an overlying operculum (Fig. 1a). The minimum diameter (horizontal scan) of the macular hole was 294 μ m, visual acuity was 20/400 with a refraction of +1.00sph/−0.25cyl 104°. The anterior segment had only an incipient cataract, and the intraocular pressure was 16 mm Hg. The axial length of the eye was 23.10 mm. The fellow eye was normal.

We performed a combined phacoemulsification with a capsular bag-fixed posterior chamber lens and a 23-gauge vitrectomy. With the vitreous still adherent to the optic disc, a complete posterior vitreous detachment and core vitrectomy was performed after staining with triamcinolone. The ILM was stained with 0.15% trypan blue and completely mobilized to the foveal base via a perifoveal-circular opening and left there as an adherent flap. The peripheral portion of the ILM was removed extensively from the posterior pole. An intravitreal gas tamponade with 20% C2F6 was performed with postoperative prone positioning for about 5 days.

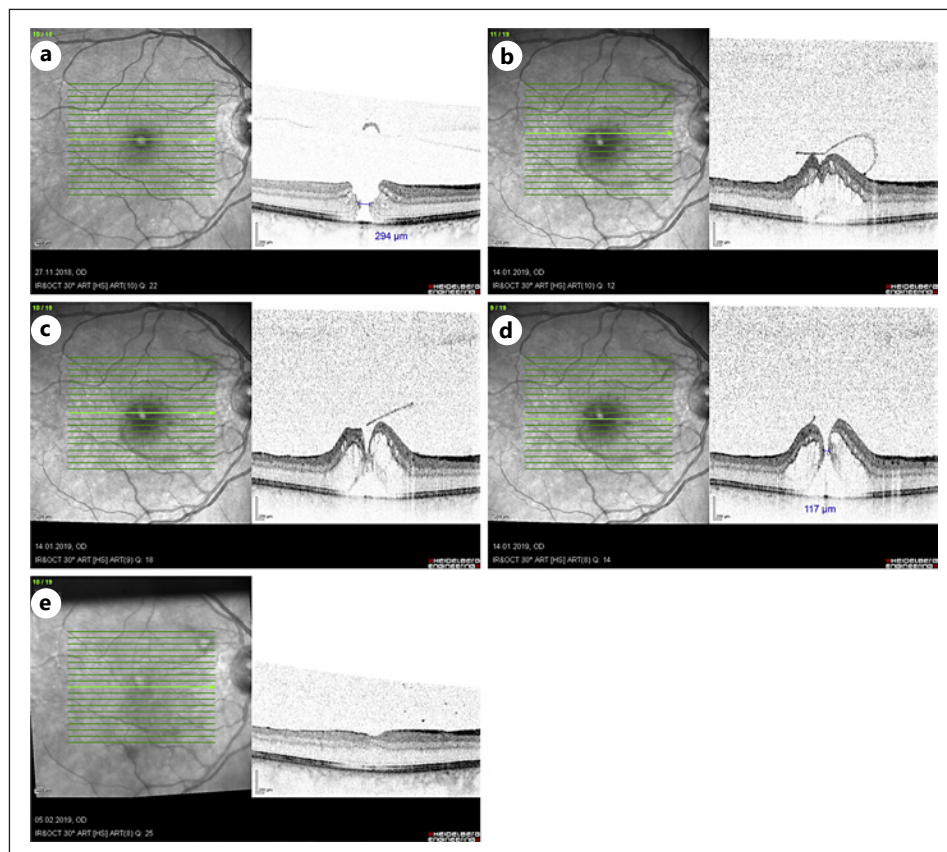


Fig. 1. **a** Full-thickness macular hole, 294 μ m diameter, floating operculum, findings at initial presentation. **b–d** Persistent macular hole after vitrectomy with inverted ILM flap, 117 μ m diameter with retinal edema at the edge of the hole, ILM flap clearly visible in **(b)** and **(c)**, partially visible in **(d)**. **e** Closed macular hole, 3 weeks after reoperation.

Four weeks after primary surgery, a macular hole with a diameter of 117 μm with cystoid thickening and retraction of the foraminal rim (Fig. 1b–d) persisted. The corrected visual acuity was 20/400, the patient described metamorphopsia. Refraction $-0.50\text{sph}/-0.75\text{cyl}$ 157° , intraocular pressure normotensive.

We performed a repeat 23-gauge vitrectomy. A flat-lying perifoveal ILM flap appeared adherent to the retina. After staining with 0.15% trypan blue, the flap was circularly peeled back to the foveal edge and left there. The eye was filled with 25% C2F6 gas to ensure a longer tamponade duration, with 5 days of postoperative prone positioning.

Almost 3 weeks after this secondary intervention, the patient presented again. The macular hole was closed (Fig. 1e) and best corrected visual acuity was 20/50 with minor metamorphopsia. OCT showed a continuous external limiting membrane and ellipsoid zone in the original defect area (Fig. 1e).

Discussion

Rizzo et al. [9] examined a series of 620 eyes. Of these, 320 eyes were treated with inverted ILM flap, and the hole closure rate was 91.93 percent. The peer group ($n = 300$) treated with ILM peeling had a hole closure rate of 78.75 percent.

In principle, a vitrectomy with complete ILM peeling would have been possible in our case. However, we had already had good experience with the inverted flap technique in several cases of macular holes with diameters $>400 \mu\text{m}$ and $<400 \mu\text{m}$ and observed high closure rates. Therefore, the decision was made to operate on the 294 μm diameter macular hole with the inverted flap. After the initial intervention, a significant macular edema was found at the edges of the persistent macular hole. On the one hand, the formation of intraretinal cysts could be explained by traumatic alteration of Müller cells as a consequence of ILM peeling. In addition, an inflammatory genesis with weakening of the blood-retinal barrier could explain the existence of cystoid macular edema [10]. Therefore, in our case, one option would have been to initially give topical or parabolbar steroids with the aim of resolving the cystoid edema and hole closure after the hole diameter had already decreased compared to the preoperative findings. However, we wanted to take advantage of the ILM flap and therefore decided on a reoperation with flap repositioning.

Michalewska and Nawrocki [11] studied 32 cases of persistent macular holes after inverted flap surgery. The flap had reverted perifoveally to its original position. They performed repeat vitrectomy with flap repositioning and air tamponade ($n = 12$) as well as silicone oil tamponade ($n = 20$). Twenty-nine closed after the second procedure and three after a third procedure. In this series, they found improved visual acuity in 87.5%. The average minimum diameter of the 32 persistent macular holes was larger (before first surgery: 519 μm ; before second surgery: 392 μm) than that in our case (before first surgery: 294 μm ; before second surgery: 117 μm).

The mechanisms of hole closure using the inverted ILM flap technique have not been fully understood. It is thought that the ILM flap creates a bridge or track for Müller cell proliferation and migration. Activated Müller cells secrete neurotrophic factors that can promote the growth of photoreceptor cells and retinal neurons [12]. Centripetal movement during spontaneous macular hole closure is mediated by contraction of Müller cell processes in the outer plexiform layer and contraction of Müller cell components enclosing photoreceptors in the external limiting membrane [13].

In our opinion, the contractile elements within the remaining ILM [14] could cause the flap, which is only attached to the foveal ring, to induce a ring-shaped closure of the macular hole by centripetal contraction. In the case described, the flap preparation may not have

been sufficiently close to the foveal edge during the initial operation, so the flap was able to reattach itself perifoveally, and the contractile centrifugally acting elements prevented a hole closure.

In our experience and according to the results of Michalewska and Nawrocki, revision surgery with flap mobilization seems to be effective in persistent MH after flap surgery. Prior to revision surgery, OCT should be used to check whether the ILM flap has folded back into its original position or possibly detached completely. Flap visualisation by the use of vital dyes can be performed intraoperatively. Manipulation of reverted ILM flaps appears easier when silicone oil is used instead of gas tamponade [11]. In case of complete flap loss, alternative surgical methods for refractory MHs should be considered, depending on the size of the macular hole and the surgeon's discretion.

Statement of Ethics

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. This study protocol was reviewed and approved by the local Institutional Review Board (Ethik-Kommission, Bayerische Landesärztekammer), approval number 17061.

Conflict of Interest Statement

The authors of this manuscript do not have any conflicts of interest to declare.

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Author Contributions

Gregor Kastl: conception and design, data analysis and interpretation, drafting of figures, and writing of the first draft of the manuscript; Peter Heidenkummer: conception and design, data interpretation, and writing and correction of the manuscript.

Data Availability Statement

All data generated or analyzed for this case report are included in this article. Further inquiries can be directed to the corresponding author.

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