

CASE REPORT

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Macular hole reopening after inverted internal limiting membrane flap

Erin H Su, Niranjana Kesavamoorthy, Hossein Ameri

ABSTRACT

Introduction: Here, we present a case of macular hole (MH) reopening after an initial successful closure with an inverted internal limiting membrane (ILM) flap procedure.

Case Report: The patient was a 72-year-old Hispanic male who presented with decreased vision in the right eye who was found to have a 431 μ m, full-thickness macular hole. The patient underwent three separate 25-gauge pars plana vitrectomies to correct the macular hole. The first involved an inverted ILM flap technique, the second one removal of the flap and the third one subretinal injection of balanced salt solution (BSS).

Conclusion: The failure of the inverted ILM flap, we believe, was primarily due to the inferiorly attached flap being pulled down by surface tension of the rising fluid level.

Keywords: Internal limiting membrane (ILM), Inverted ILM flap, Macular hole, Macular hole reopening, Vitrectomy

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INTRODUCTION

Full thickness macular holes (MHs) are defects in the macula that involve its entire thickness. Macular hole surgeries have undergone several modifications over the years to facilitate hole closure and improve visual outcomes. Typical surgical management includes pars plana vitrectomy, gas tamponade, and internal limiting membrane (ILM) peeling [1]. Due to lower closure rates with ILM peeling, Michalewska et al. introduced the ILM flap procedure in which instead of peeling the entire ILM, a portion of the ILM is inverted to cover the hole and to induce gliosis [2]. Others have also reported that ILM flap technique was superior to ILM peeling in successful hole closure [3, 4]. Here, we present a case of MH reopening after an initial successful closure with an inverted ILM flap procedure.

CASE REPORT

A 72-year-old Hispanic male presented with decreased vision in the right eye, and on fundus exam and optical coherence tomography (OCT) imaging, was found to have a primary, full-thickness macular hole measuring 431 μ m (Figure 1A). Initial uncorrected visual acuity in the right eye was 20/125, without improvement with pinhole. The patient underwent a 25-gauge pars plana vitrectomy. During posterior hyaloid detachment, pinpoint bleeding arose at a vitreous tuft, which was treated with endolaser to prevent retinal detachment in case of potential micro-breaks. The ILM was stained with indocyanine green, peeled around the hole. The ILM flap was trimmed, and inadvertently separated from the edge of the hole except for the inferotemporal edge. Fluid–air exchange was

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Erin H Su¹, Niranjana Kesavamoorthy¹, MBBS, Hossein Ameri¹, MD, PhD, FRCSI, MRCOphth

Affiliations: ¹Department of Ophthalmology of USC Roski Eye Institute, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA.

Corresponding Author: Hossein Ameri, USC Roski Eye Institute, 1450 San Pablo St, Los Angeles, CA 90033, USA; Email: ameri@med.usc.edu

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performed and the created flap was inverted to cover the hole (Figure 2A). Then gas–air exchange was performed with 14% C₃F₈. The patient postured face-down for one week. At week one, when the vitreous cavity was 60% gas-filled, the macular hole appeared closed. At postoperative week six, when there was only a residual gas bubble in the vitreous cavity, the macular hole appeared to reopen, with the folded ILM flap lying just below the fovea (Figures 1B and 2). Then the patient's visual acuity was 20/200. The patient underwent cataract surgery for brunescant cataract three months after vitrectomy. Six months after the first vitrectomy, the patient underwent a second vitrectomy in which the ILM flap was removed, gas–air exchange was performed with 14% C₃F₈, and the patient was again postured face-down for one week. The hole failed to close (Figure 1C); therefore, two months later, a third vitrectomy was performed, in which the ILM was peeled further to include the entire macula and, through subretinal injection of balanced salt solution, three subretinal blebs were created at the superotemporal, temporal, and inferotemporal macula using a 25/38-gauge subretinal needle (Figure 3). Face-down posturing was again done for one week. Postoperatively, the macular hole was shown to have successfully closed, and the best corrected visual acuity was at 20/80 one year after the last vitrectomy (Figure 1D).

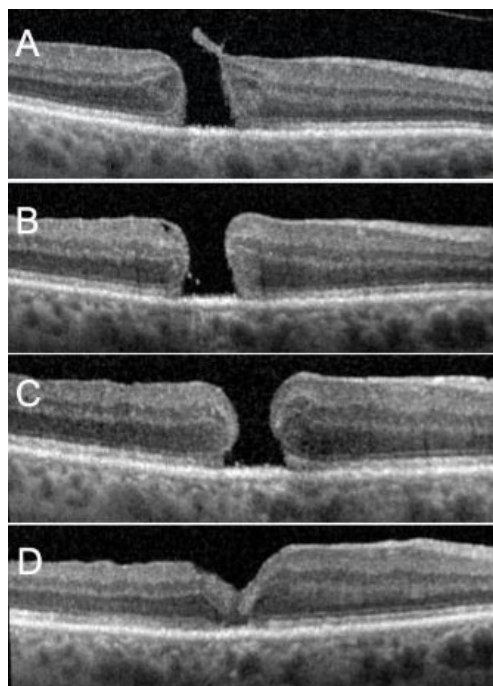


Figure 1: Optical coherence tomography (OCT) images of the patient's right eye before and after MH surgical interventions. (A) Preoperative OCT image before any intervention, with a MH minimum diameter of 431 μ m and base diameter 632 μ m. (B) Postoperative OCT image six weeks after the first vitrectomy, with a MH minimum diameter of 438 μ m and base diameter 690 μ m. (C) Postoperative OCT image four weeks after the second vitrectomy, with a MH minimum diameter of 323 μ m and base diameter 611 μ m. (D) Postoperative OCT image five months after third vitrectomy, with macular hole remaining closed.

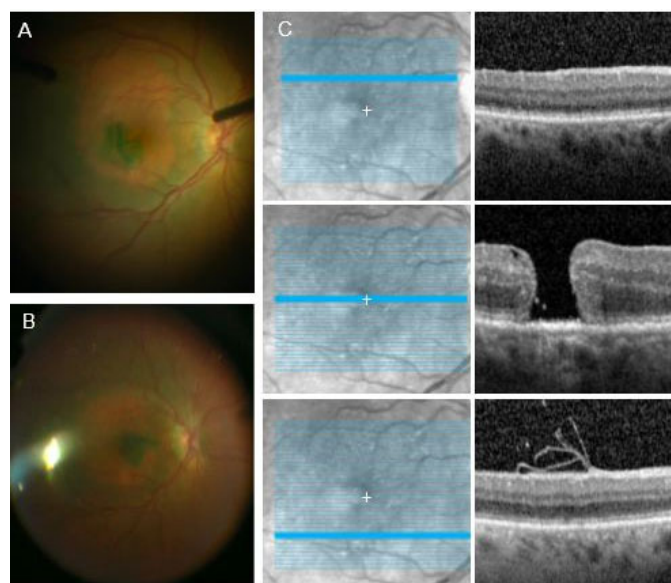


Figure 2: Fundus photographs and optical coherence tomography (OCT) images of the patient's right eye. (A) Intraoperative photo before air–fluid exchange showing the ILM flap separated from all edges of the macular hole except inferotemporally. (B) Photo after fluid–air exchange showing the flap was folded over the hole and was covering the hole at the conclusion of surgery. (C) Optical coherence tomography above, at, and below the hole (cross) six weeks after the first vitrectomy showing several layers of ILM flap below the hole but no flap on or above the hole.

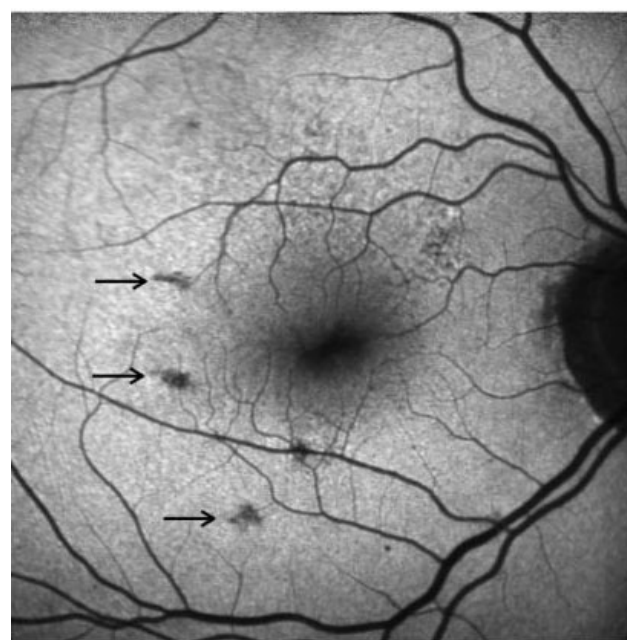


Figure 3: Fundus autofluorescence image six months after the third vitrectomy showing hypo-autofluorescence spots (arrows) at the locations that retina was penetrated for creation of subretinal blebs.

DISCUSSION

Postoperative MH reopening have previously been reported, with instances occurring between 2 and 28

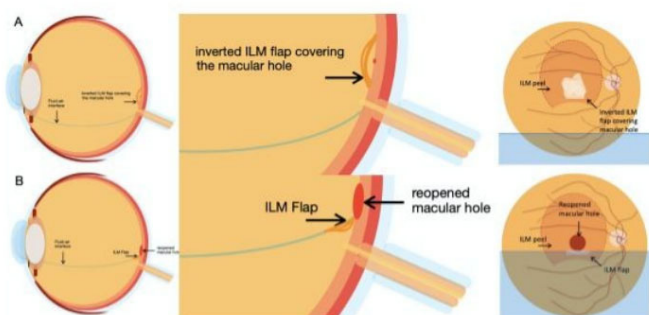


Figure 4: Diagram of surface tension's potential role in the reopening of the macular hole after the first vitrectomy. (A) The hole is closed when the fluid–air interface is below the macular hole. (B) Because the flap is only attached to the inferotemporal edge of the hole, the interface pulls on the lower edge of the hole eventually opening it.

months [5–7]. The mechanisms behind MH reopening include, but are not limited to, iatrogenic retinal injury, impaired healing, and retinal elevation secondary to cystoid macular edema and epiretinal membrane growth and resulting tractional forces [5, 6, 8]. Here, we present another potential mechanism for MH reopening.

Since Michalewski et al.'s inverted ILM flap technique, inverted ILM flaps have been shown to further reduce MH recurrence [2, 4]. In Hu et al.'s 2019 study, myopic MH closure rate significantly improved from 66.7% to 100% following inverted ILM flap versus ILM peeling [4]. In our case, an inverted ILM flap may have contributed to the reopening of the hole. Intraoperatively, the ILM flap was separated from the macular hole edges except for the inferotemporal edge. Despite inverting and folding the ILM flap such that it covered the hole's entire surface at the end of the surgery following air–fluid exchange, on the postoperative OCT, following MH reopening, and during the second pars plana vitrectomy, the ILM flap was observed to be folded over the retinal surface at and below the inferior edge of the hole. It is possible the ILM slipped downward during fluid–air exchange or in the early postoperative period; however, in our case, we believe that focal inferotemporal attachment of the flap may have resulted in the reopening of the hole. Considering the hole was 431 μm large, it would likely have closed without an inverted ILM flap. We hypothesize that as the fluid–gas interface rose and reached the lower MH edge, the surface tension of the fluid may have pulled the flap down and reopened the hole (Figure 4). This mode of ILM flap reopening, to the best of our knowledge, has not been observed previously.

This case demonstrates that inverted ILM flap may not be an entirely harmless procedure, and we suggest it be reserved for large holes. Additionally, if an inverted ILM flap procedure is pursued, we suggest creating the flap in such a way that its attachment is preserved at all edges of the macular hole or at least at the superior

edge; this way, as the fluid–gas level rises, surface tension equally pulls all the edges or in the case of the attachment to the superior edge, that edge is pulled toward the center of the hole.

Given the high success rates of reoperation on previously reopened MH cases (as high as 80% per Reid et al.), we decided to proceed with further surgical correction [7]. After the macular hole reopened, the next pars plana vitrectomy failed due to retinal adherence to the retinal pigment epithelium (RPE), thereby preventing proper contraction and subsequent closure of the macular hole post-ILM peel. For the third (and successful) vitrectomy, the attempted subretinal injections were done to try to better facilitate hole closure after prior ILM peel failures, as per the literature [9] (Figure 3).

CONCLUSION

In conclusion, our case highlights that case selection and proper surgical technique are important in using inverted ILM flap for macular hole repair. Separation of the ILM flap from superior edges of the macular hole and attachment only to the inferior edge of the hole may result in reopening of the macular hole.

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Author Contributions

Erin H Su – Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Niranjana Kesavamoorthy - Interpretation of data, Drafting the work, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Hossein Ameri – Conception of the work, Design of the work, Analysis of data, Interpretation of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Guarantor of Submission

The corresponding author is the guarantor of submission.

Source of Support

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Consent Statement

Written informed consent was obtained from the patient for publication of this article.

Conflict of Interest

Authors declare no conflict of interest.

Data Availability

All relevant data are within the paper and its Supporting Information files.

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ABOUT THE AUTHORS

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Erin H Su is a medical student at Keck School of Medicine at USC. She earned her undergraduate degree at Pomona College. She has published two research papers in national and international academic journals. Her research interests include clinical ophthalmology and infectious diseases. She intends to pursue ophthalmology residency in the future after graduation.
Email: erinsu@usc.edu



Niranjana Kesavamoorthy is a research fellow at the University of Southern California. She earned her medical degree (M.B.B.S.) from Madras Medical College, Chennai, India. She has published a research article and 6 case reports in national and international journals. Her research interests include CRISPR cas9 gene editing, gene therapy, and medical and surgical retina. She intends to pursue residency training in ophthalmology in the future.
Email: Niranjana.Kesavamoorthy@med.usc.edu



Hossein Ameri is an Associate Professor of Clinical Ophthalmology at USC Roski Eye, and the Director of USC Retinal Degeneration Center. His clinical practice comprises vitreoretinal surgery and medical retina including inherited retinal diseases. His research experience includes retinal prosthesis, retinal angiogenesis, and retinal gene therapy. Currently, his lab is focused on developing treatments for retinal diseases through gene therapy.
Email: ameri@med.usc.edu

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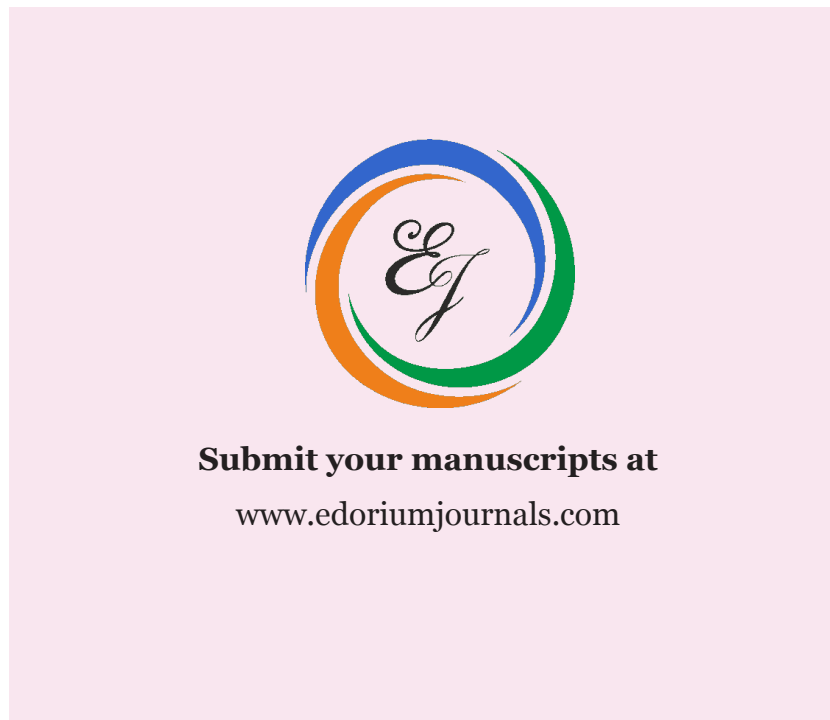
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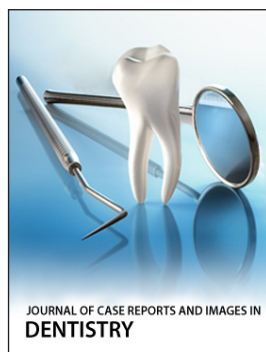
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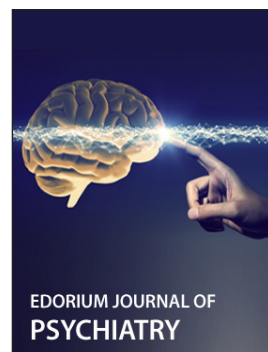
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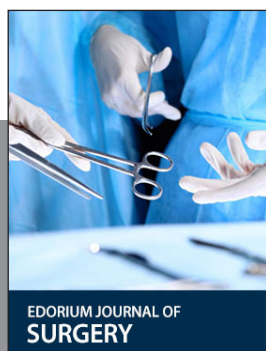
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