CASE REPORT

Long-term outcomes of free internal limiting membrane transplant for unclosed macular holes after extensive internal limiting membrane peeling and silicone oil tamponade: a report of two cases

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Abstract

We report the long-term outcome of two cases of free internal limiting membrane (ILM) transplant for unclosed macular holes after extensive internal limiting membrane peeling and silicone oil tamponade. Free ILM graft was harvested and then successfully tucked against the inner edges of the macular hole in two eyes. All macular holes closed. In one case, the ILM filled the macular hole 100% in all meridians and remained closed 7 years after surgery. In another case, the ILM filled the gap of the macular hole 100% in the horizontal meridian and approximately 70% in the vertical meridian and re-opened 5 weeks after surgery. Filling the entire macular hole area with the ILM graft may improve long-term anatomical outcomes.

Introduction

The first randomized controlled study of internal limiting membrane (ILM) peeling on macular hole surgery was published in 2005.[1] Subsequently vitrectomy with ILM peeling has been shown to significantly improve the anatomical and visual outcomes of idiopathic full-thickness stage 2, 3, and 4 macular holes.[1,2] In order to avoid the demanding face-down posturing after idiopathic macular hole surgery, intraoperative broad ILM peeling up to the temporal vascular arcades has been reported.[3] The combination of these techniques gives the patient the best chance of macular hole closure with postoperative comfort. However, not all macular holes close after this approach, especially those that are large and chronic.[4-8] The inverted ILM flap technique for large primary macular holes has been reported with encouraging results.[4] However, this technique is unsuitable for eyes with unclosed macular holes after previous surgery with extensive ILM peeling and silicone oil tamponade. We herein describe the long-term outcomes of two patients who underwent a novel free ILM transplant technique for treating unclosed macular holes after previous surgery with extensive ILM peeling and silicone oil tamponade.

Case presentation

Case 1

On 22 February 2011, a 52-year-old Chinese man presented with loss of right eye vision after an impact from a soccer ball 1 week before. His past health was unremarkable, except for having undergone bilateral laser-assisted in situ keratomileusis (LASIK) in 2011 and left conductive keratoplasty for presbyopic correction in 2008. On examination, unaided distant visual acuity was hand movement for the right eye and 20/25+2 for the left eye. The right eye was found to have traumatic hyphaemia, cataract, and vitreous hemorrhage without fundal view. Intraocular pressure was 5 mmHg for the right eye and 24 mmHg for the left eye. Ultrasonography of the right eye had been performed 1 day before at a different hospital, and cataract and vitreous surgery had been advised. Left eye examination results were unremarkable.

On 24 February 2011, phacoemulsification, intraocular lens implant, and vitrectomy of the right eye were performed. Intraoperatively, the temporal half of the retina was found detached with superior retinal dialysis associated with multiple retinal holes, as well as a macular hole and holes temporal and inferotemporal to the macula. The macular epiretinal membrane and extensive macular ILM were removed from arcade to arcade with staining by Membrane Peel (Dutch Ophthalmic, USA). The retina was then fully reattached with heavy liquid, retinal endophotocoagulation, and silicone oil tamponade.

On 9 April 2011, unaided distant visual acuity of the right eye was 20/300. The retina was fully reattached, but a macular hole remained open. We discussed with the patient about the inverted ILM flap technique and the free ILM transplant technique (which had not been reported in the world). After consultation, the patient agreed to another vitreous surgery with free ILM transplant.

On 26 April 2011, repeat vitrectomy with oil removal was performed. The ILM outside the inferior vascular arcade was stained with Membrane Blue (Dutch Ophthalmic, USA), and a piece of the ILM similar in size to the macular hole was harvested and then tucked against the inner edges of the macular hole. The ILM filled the gap of the macular hole 100% in the horizontal meridian and approximately 70% in the vertical meridian. Silicone oil was re-instituted.

On 3 May 2011, unaided distant visual acuity of the right eye was 20/300+. Optical coherent tomography (OCT) at 5 weeks showed that the retina was fully reattached, and the macular hole was completely closed (flat/close), except for a suspicious gap (flat/open) in the 300° meridian scan (**Figure 1**).

On 2 June 2011, unaided distant visual acuity of the right eye remained 20/300+. The retina was fully reattached, but the macular hole re-opened. Further macular hole surgery was declined. His eye condition remained stable at the most recent follow-up in 2019.

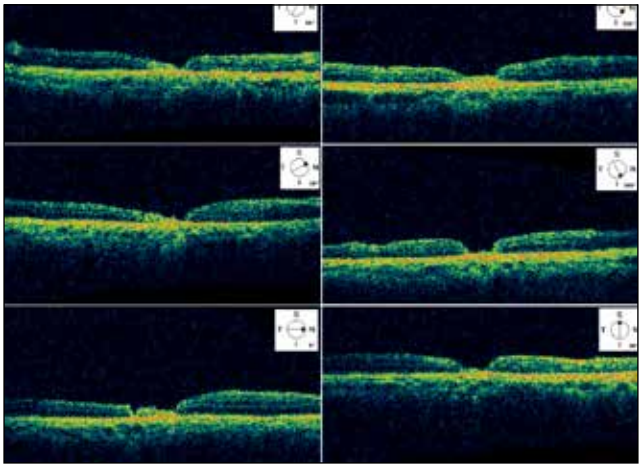

Figure 1. Patient 1: optical coherent tomography scans of the right eye at 5 weeks after free internal limiting membrane transplant showing the fully reattached retina and the completely closed (flat/close) macular hole, except for a suspicious gap (flat/open) in the 300° meridian scan.

Case 2

On 11 July 2011, a 41-year-old Chinese man presented with a history of poor right eye vision with a macular hole since age 7 years. His past health was unremarkable, except for having undergone right inferior laser barrier during adolescence. On examination, aided distant visual acuity was 20/150 (-2 D) for the right eye and 20/20 (-2.75 D/-0.75×180) for the left eye. Ocular examination using OCT was unremarkable, except for the presence of a right chronic stage 4 macular hole with a large rim of subretinal fluid and inferior peripheral retinal laser marks (**Figure 2a**). Management options (observation, vitrectomy with gas or oil tamponade, and sequential or combined cataract and vitreous surgery) for the right chronic macular hole was discussed, with very guarded prognosis.

On 2 September 2011, phacoemulsification, intraocular lens implant, vitrectomy, extensive macular ILM peeling, and silicone oil tamponade of the right eye was performed. Postoperatively, right eye vision was stable, and the macular hole was smaller with almost complete resolution of subretinal fluid but did not fully close (**Figure 2b**). We discussed with the patient about the inverted ILM flap technique and the free ILM transplant technique (which had not been reported in the world). After consultation, the patient agreed to another vitreous surgery with free ILM transplant.

On 20 January 2012, vitrectomy of the right eye with oil removal was performed. The ILM outside the inferior vascular arcade was stained with Membrane Blue (Dutch Ophthalmic, USA) and two pieces of ILM larger than the macular hole were harvested and tucked against the inner edges of the macular hole. The first ILM did not fill the macular hole 100% in all meridians. A second piece of ILM was added to fill the macular hole 100% in all meridians. A two-stage air/fluid exchange was performed, followed by air / 12% perfluoropropane gas exchange. Through the gas

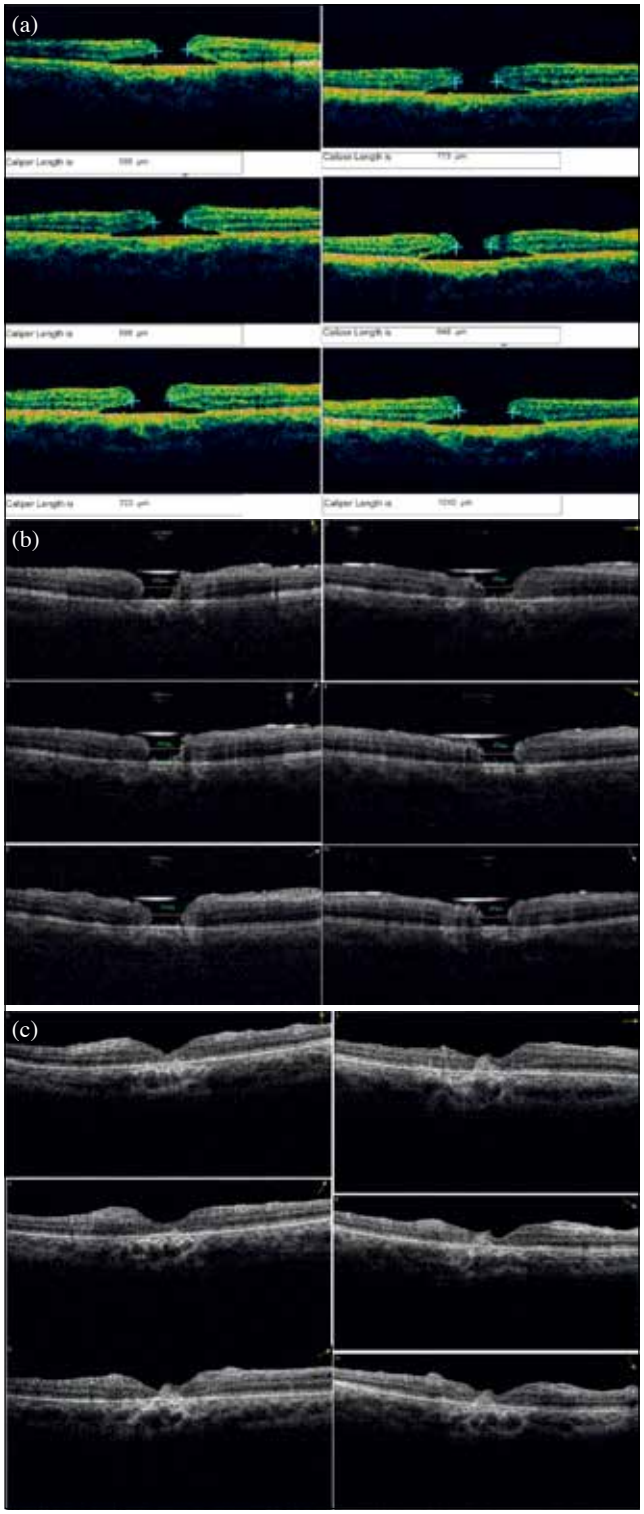

Figure 2. Patient 2: optical coherent tomography scans of the right eye (a) before the first macular hole surgery showing the presence of a chronic stage 4 macular hole with a large rim of subretinal fluid; (b) before free internal limiting membrane transplant showing the smaller macular hole with almost complete resolution of subretinal fluid but did not fully close; (c) after free internal limiting membrane transplant showing the remained closed macular hole at 26 months.

bubble, the macular hole was seen stained blue by the stained ILMs. For the first 2 weeks postoperatively, the patient was advised to adopt a reading posture when awake and lying lateral when sleep.

On 20 February 2012, his unaided visual acuity of the right eye was 20/200-, with a closed macular hole. On 15 April 2014, aided distant visual acuity of the right eye was 20/150+. The patient considered that right eye vision was subjectively improved. At 26 months after surgery, OCT showed that the macular hole remained closed (**Figure 2c**). He subsequently developed glaucoma in the right eye that was finally controlled by trabeculectomy surgery with mitomycin C. His visual acuity and eye condition remained stable at the most recent follow-up in 2018.

Discussion

To the best of our knowledge, these are the first two patients worldwide to undergo free ILM transplant for treating unclosed macular holes after previous surgery with extensive ILM peeling and silicone oil tamponade. We herein report the long-term outcomes of this novel treatment. Morizane et al[5] reported a similar technique in five eyes with failed primary macular hole surgery, with four holes closed. Their first case was performed 15 months after our first case and they did not report whether these macular holes received extensive ILM peeling and/or silicone oil tamponade in previous surgery. Intraoperatively, they used an ILM graft of similar size to that of the macular hole. Additionally, they used a viscoelastic device to help keeping the graft in place. We advocate to use one or more layers of ILM graft larger than the size of the macular hole for several reasons. Firstly, the ILM graft is elastic and curls over itself, decreasing the overall size. Secondly, a larger graft is easier to tuck against the edge of the macular hole, which then has a greater chance of staying in place without the need of injecting a viscoelastic device. Such a procedure might open up the macular hole further and dislodge the graft inadvertently or distort the surgical view of the macula. However, some surgeons use a viscoelastic device to lift the edges of the macular hole, especially in flat or open holes, to facilitate tucking in of the graft material. Thirdly, a larger graft provides a larger number of Muller cells, as well as a larger scaffold for Muller cells to proliferate. These are essential for macular hole closure.[4] Morizane et al asked the patients to stay face down for 3 days after surgery; however, we believe that this is unnecessary as long as extensive ILM is peeled and the ILM graft fills the entire macular hole.[3] In addition, they did not report any long-term change of the implanted ILM; they only showed OCT scans from 14 days and 3 months after surgery.[5] In summary, the novel free ILM transplant technique is a viable option to treat unclosed macular holes after previous surgery of extensive internal limiting membrane peeling and silicone oil tamponade. Other sources of graft material, include contralateral ILM graft, autologous neurosensory retinal transplantation, and lens capsular flap transplantation.[6-8] Further studies are needed to determine the best graft sizes for different graft materials.

Author contributions

Concept or design: AKHK.
Acquisition of data: AKHK.
Analysis or interpretation of data: AKHK.
Drafting of the article: AKHK.
Critical revision for important intellectual content: AKHK.

The author had full access to the data, contributed to the study, approved the final version for publication, and takes responsibility for its accuracy and integrity.

Conflicts of interest

As an editor of the Journal, Dr Alvin KH Kwok was not involved in the peer review process for this article.

Declaration

Presented in part at (1) Conjoint Grand Round held by Departments of Ophthalmology, Hong Kong Sanatorium and Hospital, Hong Kong East Cluster, Queen Mary Hospital and University of Hong Kong, and United Christian Hospital, December 2011; and (2) Meeting, Department of Ophthalmology, Yokohama City University Medical Centre, Yokohama, Japan, 7 March 2018.

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Ethics approval

This study was approved by the Hong Kong Sanatorium & Hospital Research Ethics Committee (Reference No.: 201821). The patients provided written informed consent for treatments and procedures.

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