



Central scotoma after indocyanine green assisted fovea-sparing internal limiting membrane peeling

Tsuyoshi Mito^{a,b,*}, Takeshi Kobayashi^a, Atsushi Shiraishi^a

^a Department of Ophthalmology, University of Ehime Graduate School of Medicine, Japan

^b Department of Ophthalmology, Kanazawa Medical University, Japan

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ABSTRACT

Purpose: To report a case with myopic traction maculopathy (MTM) that underwent fovea-sparing internal limiting membrane (ILM) peeling and developed a central scotoma with a nasal visual field defect postoperatively.

Observations: A 63-year-old man diagnosed with foveoschisis and a small outer lamellar macular hole underwent 25-gauge, 3-port pars plana vitrectomy and fovea-sparing ILM peeling using indocyanine green (ICG) staining. One year after the vitrectomy, optical coherence tomography (OCT) revealed a resolution of the macular retinoschisis and an intact ellipsoid zone at the fovea. However, macular edema was present over the area of the residual ILM, and the visual acuity had worsened to 20/200. Goldmann perimetry showed a central scotoma and a constriction of the nasal visual field. OCT angiography detected abnormal blood flow in the inner retina corresponding to the area of the residual foveal ILM. The multifocal electroretinograms were reduced in the central area.

Conclusion: The findings suggest that functional abnormalities of the fovea induced by ICG toxicity may have been manifested by a central scotoma. Therefore, surgeons need to consider the toxic effects of dyes such as ICG.

1. Introduction

In 2004, Panozzo et al. proposed the name myopic traction maculopathy (MTM) to unify the macular abnormalities, such as foveal retinoschisis, lamellar holes, and foveal detachment, that are caused by vitreous traction in highly myopic eyes.¹ To prevent a progression of the lesions associated with MTM, vitrectomy is performed to remove the traction on the retina by an epiretinal membrane (ERM), posterior vitreous cortex, or internal limiting membrane (ILM).^{2,3} However, there is a risk of intraoperative and postoperative macular hole (MH) formation from the foveal detachments in these eyes with MTM.^{4,5}

Recently, Shimada et al. described a fovea-sparing ILM peeling technique to treat eyes with MTM, and they reported good visual and anatomic outcomes without MH formation.⁶ To accomplish a complete ILM peeling, a dyeing agent such as indocyanine green (ICG) or Brilliant Blue G (BBG) is used to make the ILM more visible. ICG has been reportedly to be superior to BBG in making the ILM visible,^{7,8} however there has been some concern that it may be toxic.⁹ Nevertheless, some surgeons are still using ICG staining in patients with high myopia in which the ILM is difficult to detect.

We present our findings in an eye with MTM that underwent fovea-sparing ILM peeling with ICG staining and developed a postoperative central scotoma and a constriction of the nasal visual field.

1.1. Case report

A 63-year-old man was being followed at a local ophthalmic clinic for bilateral MTM since 2011, and his best-corrected visual acuity (BCVA) was 20/20 in both eyes for several years. However, the BCVA of his right eye gradually worsened in the past few years, and it was 20/80 in 2018. He was then referred to the Ehime University Hospital.

At his initial examination, optical coherence tomography (OCT) revealed a foveal retinoschisis and a small outer lamellar macular hole beneath a focally-thickened area in the right eye (Fig. 1). He underwent 25-gauge 3-port pars plana vitrectomy and lensectomy for a nuclear cataract with an implantation of an intraocular lens. During the vitrectomy, the central vitreous core was removed, and the posterior vitreous cortex was made more visible by triamcinolone acetate and dissected with an ILM forceps and a vitreous cutter. Then, 0.125% ICG was injected over the macular area to stain the ILM and immediately washed

* Corresponding author. Department of Ophthalmology, Ehime University Graduate School of Medicine, Shitsukawa, Toon, Ehime 791-0295, Japan.

E-mail address: mito@m.ehime-u.ac.jp (T. Mito).

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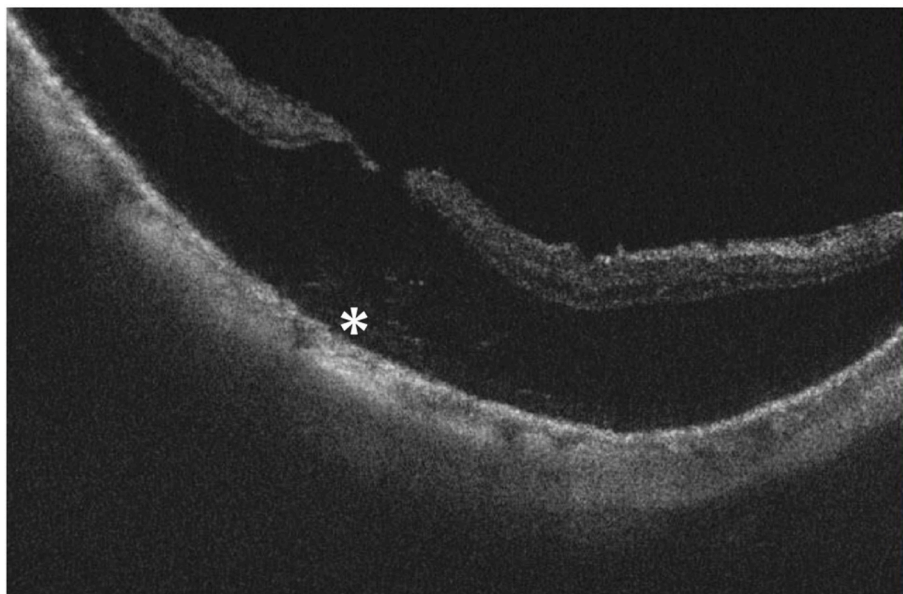


Fig. 1. Optical coherence tomographic (OCT) image of the right eye showing retinal schisis extending through the entire macula and a small outer lamellar macular hole which is present beneath the focally-thickened area (asterisk) before the vitrectomy. The OCT image is blurred because patient had moderate cataract.

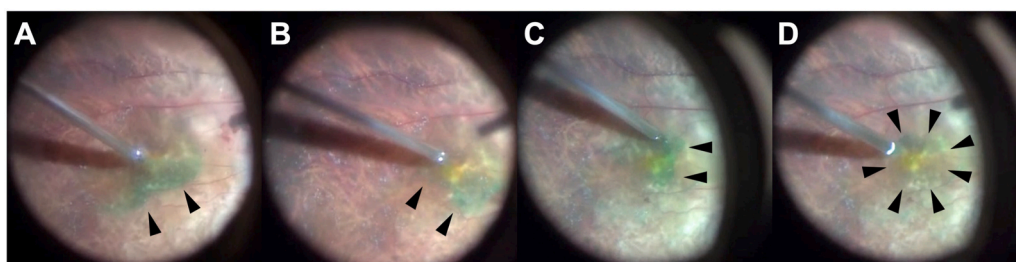


Fig. 2. Intraoperative fundus photographs. A: C: Fundus photographs showing staining of the internal limiting membrane (ILM) by 0.125% indocyanine green. The ILM was peeled toward the fovea (black arrowhead). D: ILM was peeled and trimmed from macular area except over the foveal area. The size of the area of residual ILM was about one-disc diameter. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

it out. However, we needed to repeat the ICG staining three times during the ILM removal to make ILM more visible. The ILM was peeled from the macular area except over the foveal area. The size of the residual ILM was about one-disc diameter (Fig. 2A–D).

One year later, OCT examinations revealed a resolution of the macular retinoschisis, and an intact ellipsoid zone at the fovea. However, the macular area was edematous especially the inner nuclear layer and outer plexiform layer (Fig. 3A), and the BCVA had worsened to 20/200. Goldmann perimetry showed a central scotoma and constriction of the nasal visual field of the right eye (Fig. 4). OCT angiography detected abnormal blood flow, and the en face images had a cystoid pattern in the deep retinal plexus corresponding to the area of the residual foveal ILM (Fig. 3B). The multifocal electroretinograms (mfERGs) were reduced in the central retina of the right eye, and they were smaller than that of the left eye (Fig. 5A and B).

2. Discussion

Fovea-sparing ILM peeling is an important procedure that can prevent MH formation in eyes with MTM. Our patient obtained good postoperative macular morphology without a MH, however his BCVA worsened and a constriction of the nasal visual field was present postoperatively.

Earlier studies have reported that visual field defects can develop after vitrectomy, and it has been suggested that retinal contusion from the high airflow from the infusion port during fluid-air exchange was the cause of the temporal visual field defects.^{10,11} However, we did not perform fluid-air exchange, and did not observe a rise in the postoperative intraocular pressure that might have caused the visual field abnormalities. In addition, the morphology of the optic disc was not changed after the vitrectomy, and the results of tests for a relative afferent pupillary defect was negative. The reduction in the amplitudes of the mfERGs in the central regions suggests that the central scotoma was not associated with glaucoma which results of damage of only the retinal nerve fiber layer and ganglion cell layer.

Alterations of the physiology of the retina by ILM peeling is another possible reason for the visual field defects, but it is unlikely in this case because the ILM over the foveal area was not peeled.

There have been two studies that reported that ICG toxicity may be the cause of the visual field defects after vitrectomy.^{12,13} Most of the cases reported had nasal visual field defects, but the authors did not definitively determine the cause of the visual field defects. There is a possibility that part of the ICG dye had remained on the temporal retina while the ICG on the nasal retina was washed out because of the location of the perfusion port.

The central scotoma in our cases was located where the ILM

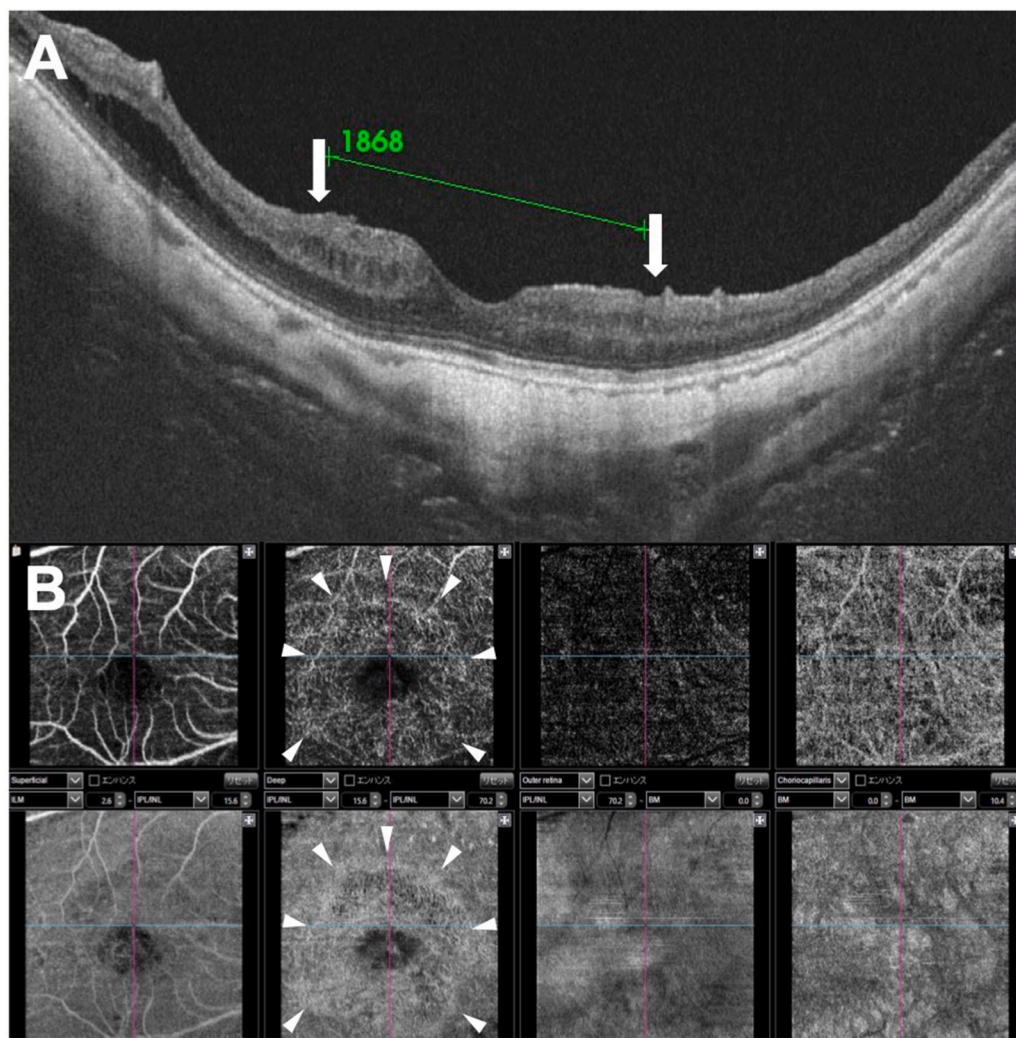


Fig. 3. Optical coherence tomographic (OCT) images of the retina one year after the vitrectomy. **A:** OCT image shows anatomical improvement of the macular schisis. The ellipsoid zone can be seen to be intact but macular edema is present especially in the inner nuclear layer and outer plexiform layer corresponding to the area of residual ILM (white arrow). **B:** OCT angiography (upper section) showing abnormal blood flow, and en-face image (lower section) shows cystoid pattern in the deep retinal plexus corresponding with the area of residual ILM (white arrowhead).

remained on the fovea. We suggest that the remaining ILM stained with ICG might be related to the central scotoma. Tognetto et al. reported a case of ICG-related central visual field disorder and observed an extensive, diffuse whitening and thickening of the macular region on the day after the vitrectomy for ERM removal using 0.05% ICG for ILM staining.¹⁴ They suggested that the ICG might have come into contact with the ILM-free retina and penetrated into the deeper retinal layers. However, the ILM was not peeled off the macular region in our case, and we did not observe a retinal whitening or intense macular edema in the early period after the vitrectomy.

There are at least two possible reasons why the central scotoma developed in our case. First, ICG staining was performed several times during surgery because it was difficult to see the ILM in the myopic eye. As a result, a relatively higher amount of ICG may have accumulated on the ILM which was not washed out at the completion of the fovea-sparing ILM peeling. Enaida et al. reported that severely deformed retinal structures and a partial disappearance of the retinal pigment

epithelium in light photomicrographs of a rat eye after an intravitreal injection of a high-dose of ICG.⁹ They reported that the amplitudes of the ERGs were reduced after the intravitreal ICG injection. These morphological and functional alterations of the retina occurred in a dose dependent manner. Second, it is known that ICG is activated by high-power laser lights and by long duration continuous light exposure through optic fibers used for intraocular illumination.¹⁵ It is possible that an enhancement of the ICG toxicity may be another reason because it required more time to manipulate the ILM in the myopic fundus.

3. Conclusions

In summary, we report a case that developed a central scotoma after fovea-sparing ILM peeling with ICG staining of the ILM. Therefore, surgeons need to consider the toxic effects of ICG even though the frequency of adverse complication is not high.

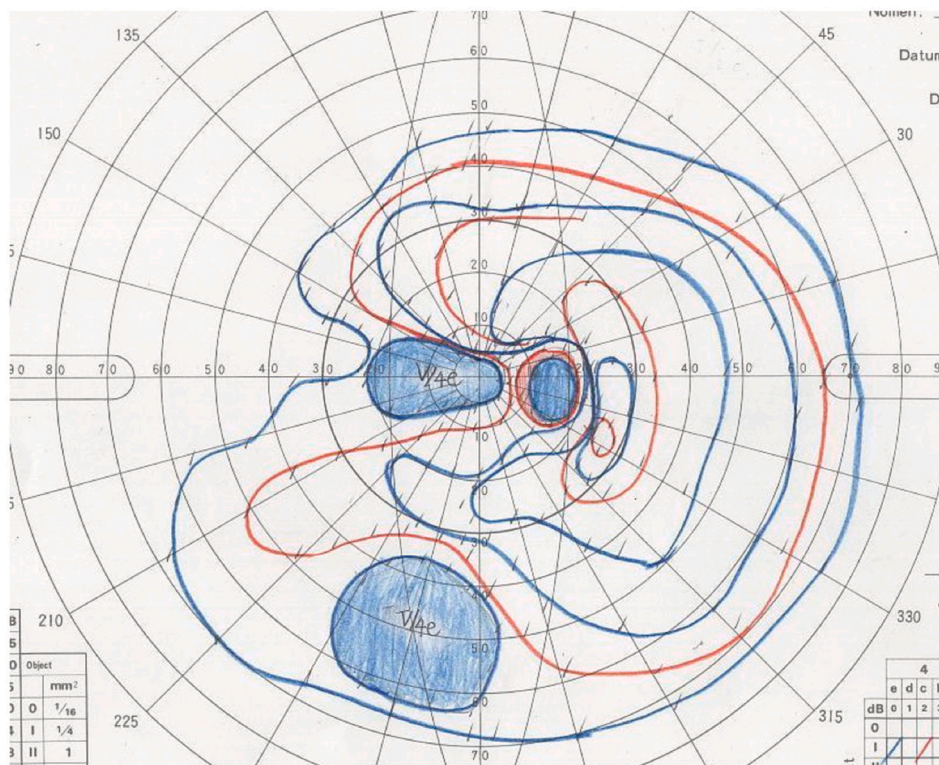


Fig. 4. Postoperative Goldmann visual fields showing central scotoma and nasal visual field defect in the right eye.

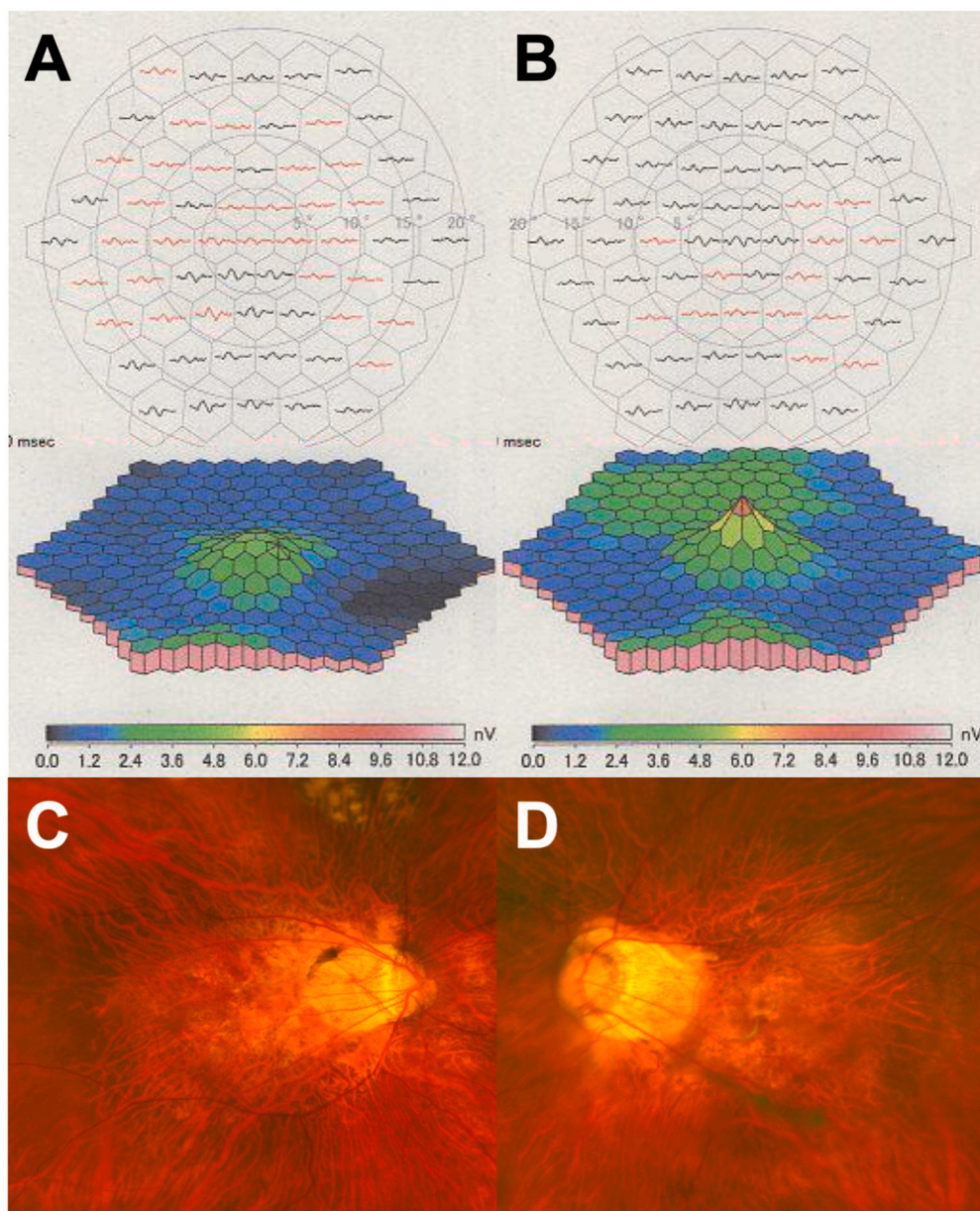


Fig. 5. Multifocal electroretinograms (mfERGs) and fundus photographs. **A:** mfERGs showing a reduction in the amplitudes in the central regions of the right eye. **B:** mfERGs of the left eye. **C:** Postoperative photograph of fundus of the right eye. **D:** Fundus photograph of the left eye.

Patient consent

Written informed consent was obtained from the patient to publish and report individual patient data.

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Authorship

All authors attest that they meet the current ICMJE criteria for authorship.

Declaration of competing interest

All authors have no financial disclosures.

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