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CASE REPORT

# Autologous neurosensory retinal free patch transplantation for persistent full-thickness macular hole

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**Abstract**
*Purpose* To evaluate anatomical and functional outcomes after autologous neurosensory retinal free patch (ANRFP) transplantation for persistent idiopathic full-thickness macular hole (iFTMH).
*Methods* A 65-year-old woman with persistent macular hole in her right eye after previous 27-gauge pars plana vitrectomy with internal limiting membrane peeling and long-acting gas tamponade underwent ANRFP transplantation. Before surgery, best corrected visual acuity in her right eye was 20/800. Optical coherence tomography (OCT) showed a 715-micron-diameter FTMH. To treat the persistent FTMH, a small autologous neurosensory retinal patch was transplanted and placed inside the macular hole under perfluorocarbon liquids (PFCL). PFCL-air exchange was performed, and long-acting gas tamponade was carried out. Clinical features of the macular area, visual acuity (VA), fundus autofluorescence, microperimetry and OCT were recorded during the 10-month follow-up.
*Results* The macular hole appeared successfully closed with retinal patch stable and well plugged into the hole during the whole follow-up. VA improved to 20/100 and microperimetry revealed an increase in mean retinal sensitivity from 14.7 dB at 1 month to 15.6 dB at 10 months postoperatively. OCT showed a well-distinguishable retinal patch into the hole 1 month after surgery and a completely integrated retinal patch between the retinal layers 10 months postoperatively. No intra- and postoperative complications were noticed.
*Conclusions* ANRFP transplantation may represent an innovative technique for persistent iFTMH treatment.

**Keywords** Idiopathic macular hole · Persistent macular hole · 27-gauge vitrectomy · Autologous neurosensory retinal free patch · Optical coherence tomography

## Introduction

A macular hole (MH) is a full-thickness defect in the center of the macular area involving the anatomical fovea [1–3]. Occasionally, it can develop in traumatized eyes but in the majority of cases it is idiopathic [4, 5]. Idiopathic MH could be defined as an age-related primary idiopathic condition, unrelated to other ocular disease or ocular trauma and usually affects women in the sixth or seventh decade of life [6]. Nowadays, pars plana vitrectomy (PPV) with internal limiting membrane (ILM) peeling and gas

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tamponade is the gold standard in the MH surgery [7, 8]. Despite high anatomical closure rate, the failure of primary surgery for MH is estimated to account for 10% of all cases [9]. This may occur due to several factors such as chronic MH, large MH, high myopia, residual epiretinal traction, insufficient gas tamponade and poor patient compliance in keeping prone position [10–12]. A persistent MH leads to a poor visual acuity as well as a risk of retinal detachment in high myopic eyes.

Current surgical strategies for persistent MH treatment include heavy silicone oil tamponade, autologous ILM transplantation and lens capsular flap transplantation [13–18]. Autologous ILM transplantation plugged into the hole represents a difficult maneuver because of ILM fragility. On the other hand, the capsular flap, even though more flexible and thicker than ILM flap, cannot be used in pseudophakic eyes with an open posterior capsule [16].

The aim of this study was to report the anatomical and functional outcomes after ANRFP transplantation in a case of persistent iFTMH.

## Case presentation

A 65-year-old woman showed a persistent MH in her right eye 2 months after previous uneventful combined phacoemulsification and 27-gauge PPV with ILM peeling and 14% perfluoropropane (C3F8) gas tamponade for a large 850 micron iFTMH. BCVA was 20/800, and dilated fundus examination (DFE) revealed a persistent MH (Fig. 1a). OCT measurement, performed at the narrowest part of the hole, showed a 715-micron-diameter FTMH with raised edges and intra-retinal fluid (Fig. 1b). To treat the persistent large MH, we considered ANRFP transplantation.

Surgery was performed under local anesthesia using the Alcon Constellation Vision System (Alcon Laboratories, Inc., Forth Worth, TX, USA) with 27-G micro-cannulas. Additional posterior pole staining with a combination of trypan blue and membrane blue G (MembraneBlue-Dual™, DORC International, Zuidland, the Netherlands) was performed to check for ILM remnants in the macula area. To treat large holes, we usually remove the ILM as extensively as possible. For this reason, there was no staining in the posterior pole confirming an adequate previous ILM peeling making difficult harvesting an ILM flap from outside the vascular arcades. A neurosensory retina harvest site was selected superiorly to the superonasal arcade. Light endodiathermy was applied in a circular manner around 1-disk diameter area of retina to avoid the risk of bleeding. A PFCL exchange was performed to keep the retina stable. A small autologous neurosensory retinal patch was cut using a vertical scissor and subsequently held using a micro-forceps. Afterward, the graft was gently moved toward the MH and placed inside the hole under PFCL which was useful to maintain the correct orientation of the graft. Subsequently, endolaser photocoagulation was applied around the donor site, PFCL-air exchange was performed, and C3F8 gas tamponade was carried out.

Postoperatively, the patient was instructed to maintain a face-down position for 1 week.

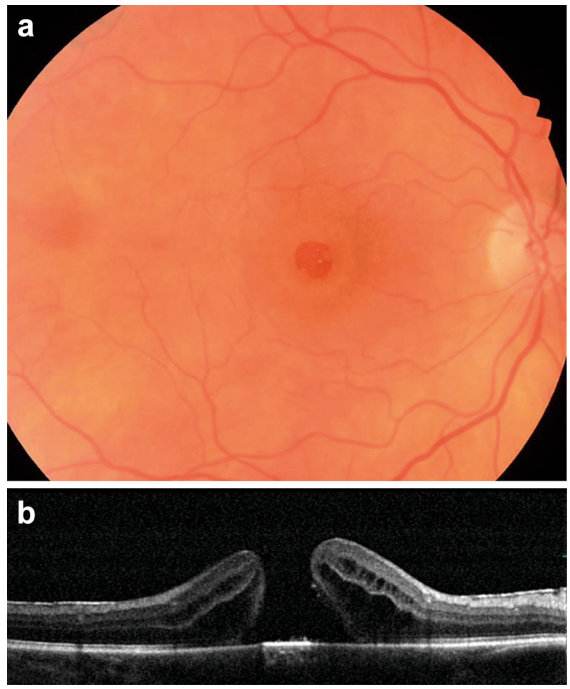
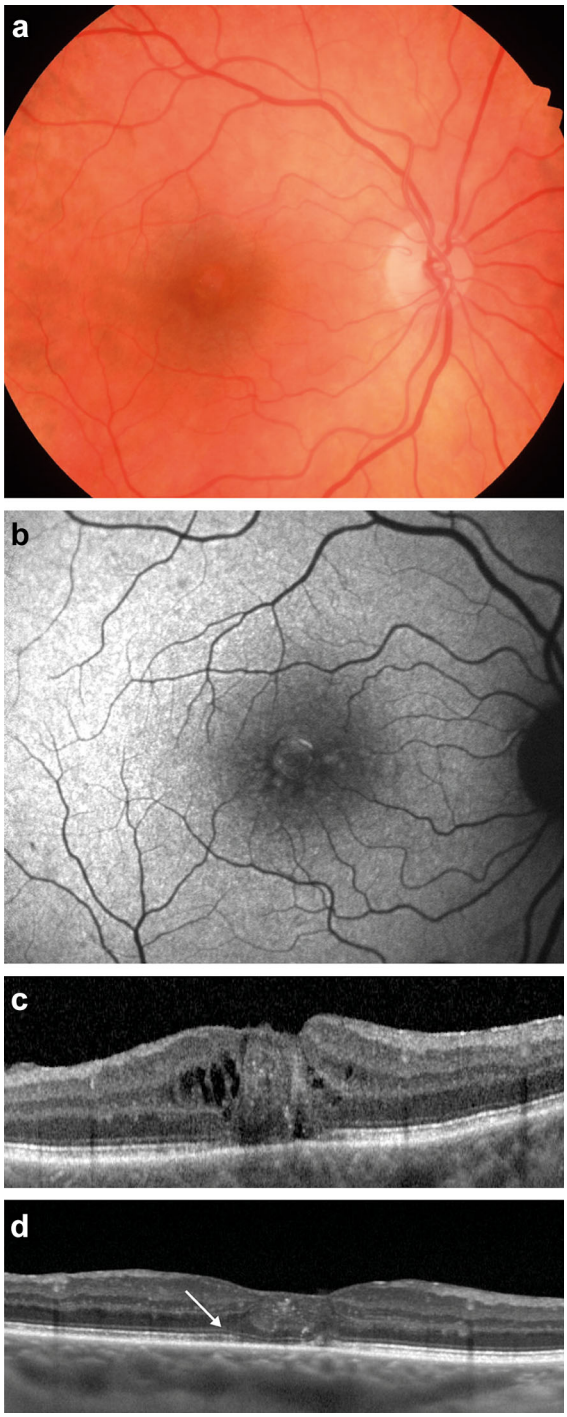



**Fig. 1** Preoperative fundus photograph and OCT scan. **a** Fundus photograph shows a persistent FTMH. **b** OCT shows a 715-micron-diameter FTMH with raised edges and intra-retinal fluid

## Results

One month after surgery, DFE revealed a closed MH with retinal patch well plugged into the hole that




◀**Fig. 2** Postoperative fundus photograph, fundus autofluorescence and OCT scan. **a** Fundus photograph shows a closed MH with retinal patch well plugged into the hole. **b** Fundus autofluorescence shows a mild hyperautofluorescence in correspondence to the flap. **c** The transplanted ANRFP is visible inside of the MH with residual intra-retinal fluid and an outer segment junction defect 1 month after surgery. **d** OCT shows the disappearance of intra-retinal fluid and a partial outer retinal band restoration (arrow) 10 months after surgery

remained stable during the whole follow-up (Fig. 2a). AF showed a mild hyperautofluorescence in correspondence to the flap (Fig. 2b). OCT reported the closure of the hole with residual intra-retinal fluid which progressively disappeared (Fig. 2c, d). A partial outer retinal band restoration was also found (Fig. 2d, arrow).

VA gradually improved from 20/400 at 1 month to 20/100 at 10 months. An increase in mean retinal sensitivity from 14.7 dB at 1 month to 15.6 dB at 10 months postoperatively was detected with microperimetry.

No intra- or postoperative complications were noticed.

## Discussion

Although PPV with posterior hyaloid removal, ILM peeling and gas tamponade is still the gold standard for a successful closure of FTMH, persistent MH remains a challenge [7–9].

Several surgical efforts have been performed to solve this condition, and the right tissue to be used as a flap is extremely important in terms of functional recovery [13–18].

Chen et al. [16] have previously described the use of anterior and posterior capsule lens to close refractory MH, due to its similar nature to ILM, reporting a significantly better closure rate with the anterior capsule flap but not a significantly VA improvement than eyes treated with the posterior one [16].

Our patient was pseudophakic with previous YAG laser capsulotomy and complete ILM peeling that appeared both very well performed, therefore capsular or ILM flap could not be taken into consideration.

Indeed, we hypothesize that ANRFP may be a good scaffold for the closure of this large MH.

To our knowledge, this is the first case where this technique has been used for persistent iFTMH closure.

Grewal et al. [18] described the use of ANRFP transplantation for refractory myopic MH complicated by retinal detachment. Differently to our case, the

authors performed 23-G vitrectomy with silicone oil tamponade [18].

Our patient reported excellent anatomical and functional outcomes during the whole follow-up. We observed the closure of MH and an improvement in VA and retinal sensitivity. OCT showed a well-distinguishable ANRFP into the hole and an outer segment junction defect 1 months postoperatively. After 10 months, OCT revealed a complete integration between ANRFP and retinal layers and a partial restoration of the outer segment junction suggesting that ANRFP acts both as a source of glial cells and as a scaffold for glial cells proliferation as hypothesized by Grewal et al [18].

In conclusion, ANRFP transplantation may represent an innovative technique for persistent iFTMH particularly when ILM flap and lens capsular flap cannot be harvested.

Further studies with a large number of patients are needed to establish the advantages of this technique and to see whether there are long-term surgery-related complications.

**Compliance with ethical standards**

**Conflict of interest** The authors declare that they have no competing interests.

**Ethical standard** The study adhered to the tenets of the Declaration of Helsinki and informed consent was obtained from the patient.

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