



Logbook of a Retinal Autograft

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Abstract

This study aimed to evaluate the prognosis of a retinal autograft that was used to treat a macular hole that occurred after repeated vitreoretinal surgeries. A patient underwent repeated vitreoretinal surgery due to retinal detachment in the right eye, and the internal limiting membrane was also removed during the surgeries. After silicone oil removal, the patient developed recurrent retinal detachment and macular hole, and for this reason a retinal autograft was applied to the macular hole and silicone tamponade was administered. The silicone oil was removed at postoperative 7 months, and the macular hole was observed to be closed on fundus examination at 18 months. The final visual acuity was 5/100. On optical coherence tomography (OCT), the hole in the detached retina was measured as 600 µm in diameter preoperatively, 1020 µm on the first postoperative day, gradually narrowed to 765 µm, and graft integration occurred. During follow-up, the accumulation of hyperreflective spots persisted on the inner surface of the graft tissue and in all vertically extending sections. In en face sections, it appeared as a hyperreflective arc between the graft and host retina with a shadowing artefact. In OCT angiography evaluation, a punctate multiple blood flow signal in the vertical axis of the graft was detected in the early phase at 3 months. This finding persisted at 1 month after silicone removal, and the flow signal disappeared with resorption of the cystic edema. These flow signals were in the same location as the areas of hyperreflective spots on structural OCT. In conclusion, structural OCT and OCT angiography are effective methods for the follow-up of retinal autograft integration into host tissue.

Keywords: Macular hole, retinal detachment, retinal autograft, free autologous retina graft, optical coherence tomography, OCT angiography

Introduction

Cases of large, complicated, refractory, or traumatic macular hole can be treated using methods such as internal limiting membrane (ILM) pedicle flap, autologous ILM graft, lens capsule graft, or autologous retinal graft, and silicone, gas, or short-term perfluorocarbon fluid can be used as an intraocular tamponade.^{1,2,3} In 2006, Grewal and Mahmoud⁴ first described autologous retinal grafting as preparing a graft from a certain region of the retina and using it to cover macular holes. Retinal

grafts can be placed preretinally over the hole, at the hole, or subretinally as a plug.⁵ Additional techniques such as using whole blood, blood clot, and viscoelastics can be added to reduce the risk of autologous retinal graft displacement.^{6,7} Optical coherence tomography (OCT) can be used both during surgery to ensure proper graft placement and in postoperative follow-up to evaluate hole closure.^{8,9,10} Although retinal autografts are mostly used in surgery for large and refractory macular holes in eyes with high myopia, they can also be used in the treatment of macular holes accompanied by retinal detachment.^{5,8,11} In this

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study, we aimed to evaluate the anatomical and functional results and effectiveness of autologous retinal graft transplantation in a patient with large macular hole and retinal detachment.

Case Reports

A 59-year-old bilateral pseudophakic man presented with a giant retinal tear and multiple rhegmatogenous detachments, attached macula, and visual acuity (VA) of 2/10 in the right eye and peripheral retinal degeneration and VA of 8/10 in the left eye. He underwent 23-gauge vitreoretinal surgery (Constellation vitrectomy unit; Constellation®, Alcon, Fort Worth, TX, USA) with silicone oil (SO) tamponade. During a 1-year follow-up period, the patient developed recurrent retinal detachment after undergoing posterior capsulectomy due to opacity and SO removal due to emulsification. Another vitreoretinal surgery was performed with membranectomy, ILM peeling, and SO exchange, and the SO was removed 4 months later. At the next follow-up visit, recurrent retinal detachment and macular hole (600 μm in diameter when the retina was elevated) were detected. The patient underwent reoperation with membrane removal and retinectomy. After retinal reattachment under perfluorodecalin, an autologous retinal free graft was obtained from the retinectomy margin in the inferior equatorial region using horizontal micro-scissors (GRIESHABER Revolution® DSP curved scissors), moved to the macular region with forceps (GRIESHABER Revolution® DSP ILM forceps), and transplanted by placing it as a plug into the macular hole.

Perfluorodecalin was first exchanged with air, then the air was exchanged with 1000 centistokes (cS) SO. The surgery was concluded by suturing the sclerotomy sites. The patient was followed up with best corrected VA measurement, intraocular pressure (IOP) measurement, clinical assessment, OCT, and OCT angiography (OCTA) (RTVue-XR Avanti system, Optovue Inc., Fremont, CA, USA). At 7-month follow-up, the SO was removed and exchanged with gas because emulsification was observed. The patient was followed for 18 months after retinal autograft surgery.

VA was hand movements (HM) preoperatively and increased to counting fingers (CF) at 1 meter on postoperative day 1, 5/100 at 3 months, CF at 2 meters at 6 months, 15/100 at 8 months (1 month after SO removal), and 5/100 in subsequent follow-up visits. Throughout follow-up he received bilateral topical antiglaucoma therapy (timolol maleate + dorzolamide). Glaucomatous pitting was observed in the right eye, and with brimonidine maleate therapy added to the right eye, IOP at last follow-up was 19 mmHg on the right and 13 mmHg on the left.

Fundus examination throughout follow-up demonstrated an attached retina and closed macular hole (Figure 1A-C). OCT showed that the retinal autograft plugged the macular hole from the first day after transplantation. The diameter of the hole was measured as 600 μm in the preoperative detached retina section, increased 1020 μm on postoperative day 1, and gradually decreased to 765 μm with graft integration. The presence of increasing cystic edema in the main retina surrounding the graft, especially in the papillomacular area, was noted from

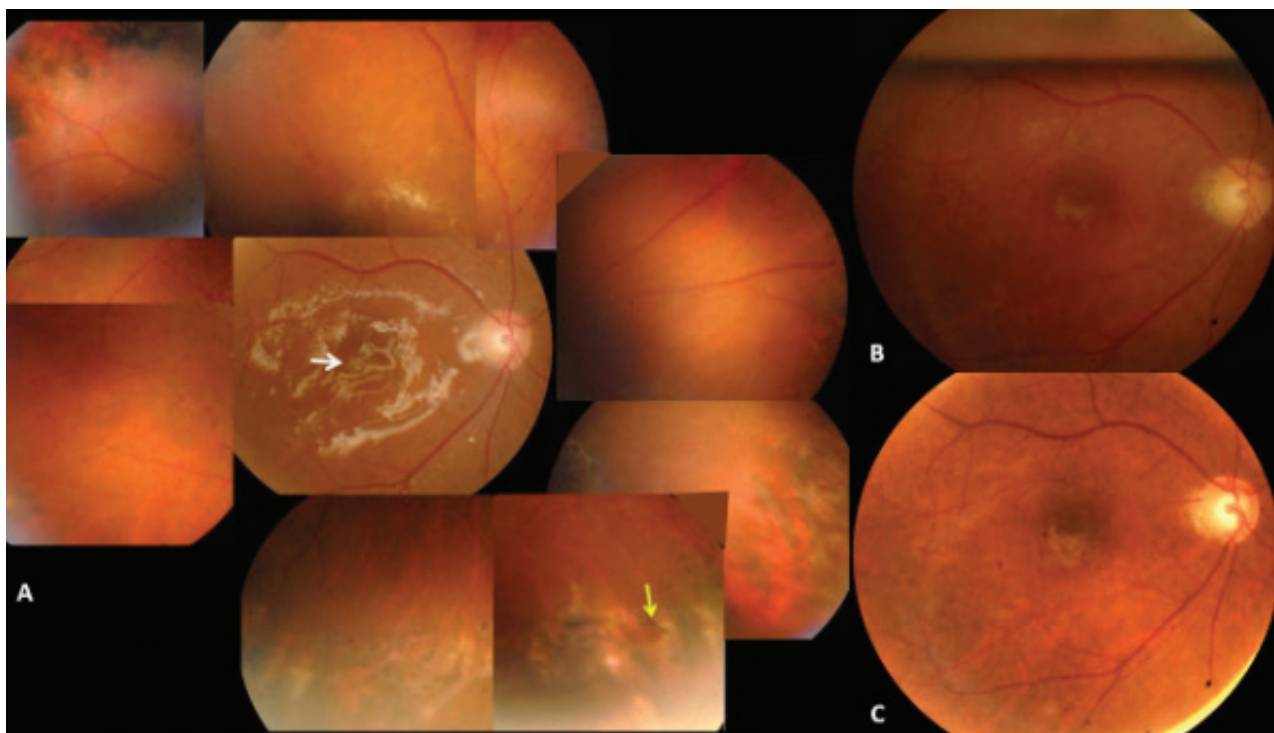


Figure 1. Fundus images of the patient's right eye after retinal autograft implantation, at A) Three months, B) Eight months (1 month after silicone oil removal), and C) Eighteen months. The retinal autograft persists in the macular hole region (The white arrow indicates the autologous retinal graft; the yellow arrow indicates where the graft was taken from)

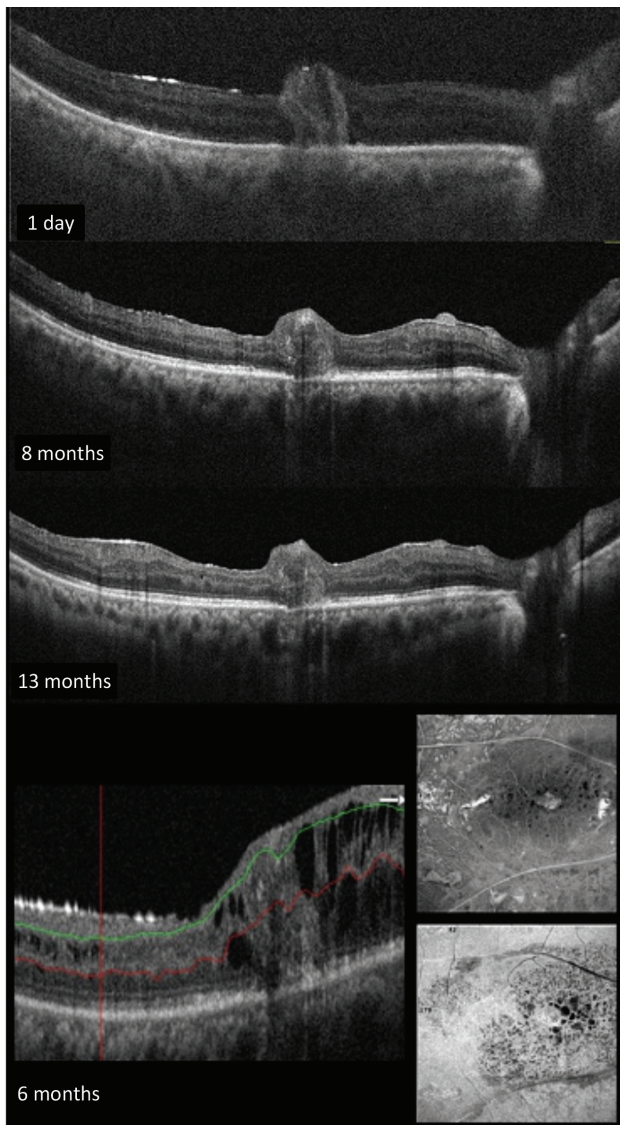


Figure 2. Optical coherence tomography (OCT) sections of the retinal autograft show vertical hyperreflective striation on postoperative day 1; multiple hyperreflective spots and shadowing in the graft tissue, loss of the vertical striation, graft integration into the host tissue at 8 months; partial continuity of the hyperreflective plexiform layers at 8 and 13 months; and marked cystic edema in the host retina in 3x3 mm area sections (shown with en face structural OCT images of the superficial and deep capillary plexus slabs) at 6 months

3-month follow-up onwards, and central macular thickness was measured as 491 μm at 6 months. The macular edema was resorbed within 2 months after SO removal, gas exchange, and sub-Tenon acetamide injection were performed at 7 months, with no recurrence observed through the end of follow-up. With resorption of the edema in the main retina, hyperreflective lines consistent with the plexiform layers extending horizontally in the graft became visible (Figure 2). Throughout follow-up, hyperreflective spots on the inner surface of the graft tissue extending vertically persisted in all sections, appearing as

a hyperreflective arc between the graft and main retina in en face sections and creating a shadowing artifact. Vertical hyperreflective striation lines were initially prominent between the graft and main retina and became indistinct over time because of cystic edema.

On OCTA, no vascular flow signal was detected in the superficial capillary plexus (SCP), deep capillary plexus (DCP), or choriocapillaris slabs in the area corresponding to the graft during follow-up, while flow intensities in the main retina remained stable (Figure 3). Punctate multiple blood flow signals were detected in the graft's vertical axis in the early period (3 months), persisted at 1 month after SO removal, and disappeared after resorption of the cystic edema (Figure 4). The location of these flow signals corresponded to the hyperreflective spots seen on structural OCT. There was no evidence of choroidal neovascularization in the en face images of the outer retina or choriocapillaris in any section.

Discussion

Over 18 months of follow-up after retinal autograft transplantation, our patient exhibited macular hole closure consistent with type 2A according to the classification system recently defined by Rossi et al.¹² in a study including 76 retinal autograft cases. In this type of closure, there is no contact between the vitreous and retinal pigment epithelial surface, and ILM, human amniotic membrane, or in our case the retinal autograft fills the macular hole, interrupting the foveal anatomy through all layers. According to the authors, there is a change in graft reflectivity over time, which they believe is related to the healing process, as well as the reformation of the ellipsoid zone (EZ) with loss of autologous retinal tissue in long-term follow-up.¹² In their study, 3.15% of eyes showed a change in closure type from 2A to 2C (marked by continuity of the outer retinal layers) between postoperative 1 and 3 months. In our case, the findings changed from type 2A to 2C during follow-up and partial continuity of the external limiting membrane was observed on OCT imaging. The retinal autograft tissue serves as a bridge for the proliferation of glial tissue between the edges of the macular hole. At the same time, Patel et al.¹³ speculated that this technique may allow for neural tissue replacement in the macular hole through possible ectopic synaptogenesis, retinal progenitor cell differentiation and integration, and/or transfer of progenitor cell material.

In macular hole associated with retinal detachment, VA increases postoperatively with complete closure.^{5,8} In a series of 19 eyes operated for macular holes with diameters of 933-1630 μm , the postoperative closure rate was 95% after a mean follow-up of 8.9 months, and VA increased by 3 lines in 74% and by 5 lines in 65% of the eyes, improving from HM preoperatively to an average of 20/500 postoperatively.⁵ Other series also reported that 74% of patients with macular hole and retinal detachment had an increase in vision of 3 lines or more.¹³ In our case, VA was HM before autograft transplantation and increased to 5/100 at the last follow-up at 18 months. Retinal reattachment also contributes to the increase in VA.

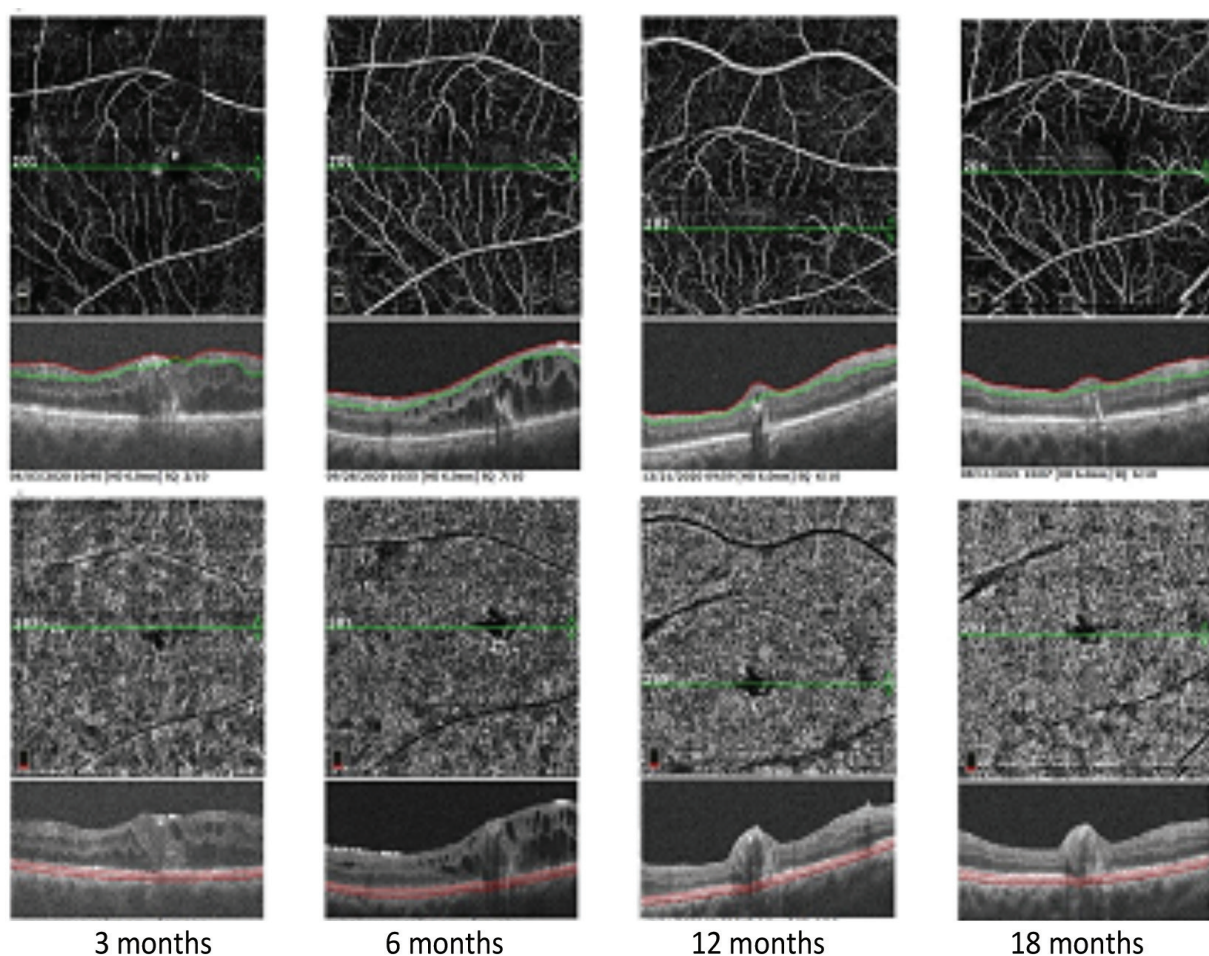


Figure 3. Optical coherence tomography angiography images of superficial plexus and choriocapillary blood flow. Flow signals in the host retina are stable at postoperative 3, 6, 12, and 18 months

Postoperative OCT imaging has demonstrated reduced disruption of the EZ, partial restoration of the external limiting membrane, graft integration into the host retina, and varying inner segment EZ visibility.^{6,11,14} Eyes with EZ restoration and continuity of the neural layers were found to have significantly better final VA.⁵ In other studies, OCT revealed a clear border between the graft and host retinal tissue at 1 month that became less distinct with time and hole closure, as well as formation of the retinal structure in the graft and reduction in hole diameter.^{15,16} Except for EZ restoration, similar changes were observed in our case.

In a study in which 11 eyes were evaluated by OCTA after retinal autograft surgery, secondary vascularization into the graft was observed in the SCP and DCP, while some eyes showed secondary tangential vessel formation in the SCP around the graft that was thought to form an anastomotic pattern between old and new vessels.⁵ In 53% of these eyes, transient hyperreflectivity in the graft was observed on OCT, appearing predominantly in the first week and resolving at 1 month without graft thinning,

which was interpreted as a sign of transient hypoxia. In another study examining 2 patients with macular holes larger than 2000 μm , it was reported that large retinal grafts tucked under the edges of the holes were integrated into the main tissue at postoperative 6 weeks, with signs of blood flow in the superficial and inner retina on OCTA and graft perfusion confirmed by fluorescein angiography.¹⁶ In another report, normal capillary perfusion was detected around the graft, supporting multifocal electroretinogram and microperimetry findings.¹¹ In our case, a vertical blood flow signal was obtained in the autograft tissue at different times during the first 9 months, while in en face sections it was seen that a narrow ring with no flow signal surrounded the graft and the hole had narrowed in diameter. The SCP and DCP appeared similar throughout follow-up. Blood flow signals detected in the graft tissue may be suggestive of retinal angiomas proliferation, but no edema was observed in the graft. The lack of a flow signal during follow-up may be attributable to resorption of the edema in the main retina resulting in the flow being completely interrupted or decreasing

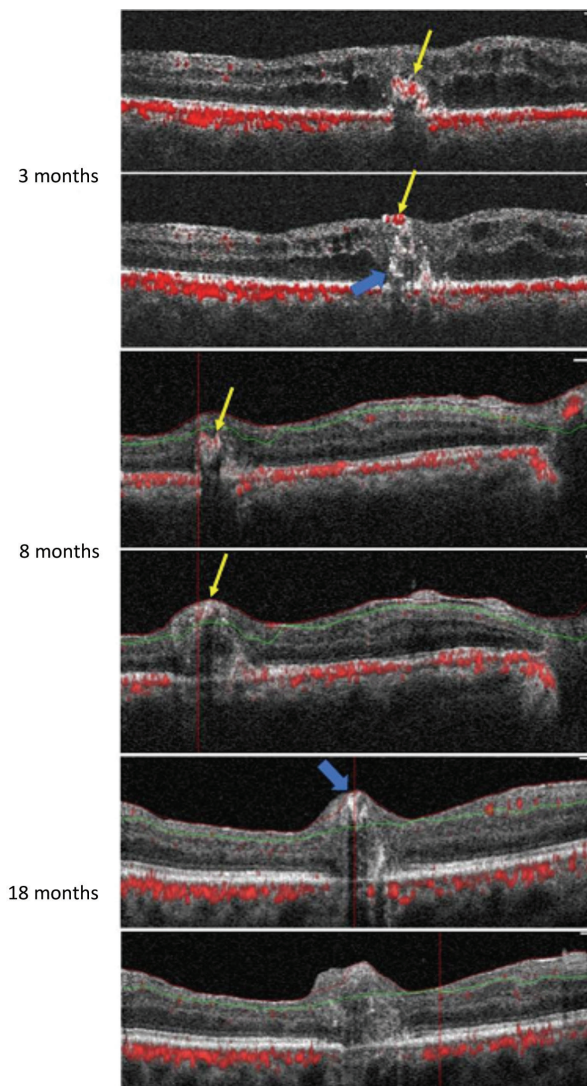


Figure 4. Optical coherence tomography angiography images of flow signals within the retinal autograft (Yellow arrows indicate flow signals, the blue arrow indicates hyperreflective points)

to a rate undetectable on OCTA. The vertical flow signal may have occurred because the graft was inserted as a plug and not placed on the base of the hole. Another possibility is that the RPE and some of the choroidal layer were also transplanted with the graft, but no sign of increased pigmentation was observed in the graft region.

Graft displacement or retraction, new or recurrent retinal detachment, vitreous hemorrhage, choroidal neovascular membrane formation, endophthalmitis, graft atrophy, graft edema, RPE hyperplasia or atrophy, subretinal perfluorocarbon droplets, and epiretinal membrane formation can be seen after surgeries involving autologous retinal grafting.^{1,5,9,10,16,17} No such complication was encountered in our case.

Autologous retinal grafting can be performed in selected cases of primary, refractory, or complicated (by retinal detachment) macular holes when other alternative methods are not possible. This technique can provide anatomical and functional improvement, with a closure rate similar to that of other methods.¹⁸

OCTA can theoretically be regarded as a useful method for understanding the mechanism by which the autologous retinal graft is integrated into the main tissue. Our study demonstrates the surgical applicability of autologous retinal grafts and the feasibility of using OCTA as a unique method for monitoring the healing process.

Ethics

Informed Consent: Obtained.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Z.Y., M.E.K., D.G., Concept: D.G., C.G., Design: D.G., C.G., Data Collection or Processing: D.G., C.G., Analysis or Interpretation: D.G., C.G., Literature Search: D.G., Writing: D.G., C.G.

Conflict of Interest: No conflict of interest was declared by the authors.

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