Autologous Transplantation of Simple Retinal Pigment Epithelium Sheet for Massive Submacular Hemorrhage Associated With Pigment Epithelium Detachment

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Purpose. To evaluate the long-term outcome of autologous simple RPE sheet transplantation in patients with simultaneous massive submacular hemorrhage and pigment epithelium detachment (PED).

Methods. Fourteen patients with 10 occult AMD eyes and 4 PCV eyes underwent a surgical procedure including a 180° peripheral temporal retinotomy, choroidal neovascular membrane (CNVM) excision, and transplantation of an autologous simple RPE sheet developed from the PED region outside the CNVM lesion. Best-corrected visual acuity, multifocal ERG, and microperimetry were recorded to evaluate macular function. Optical coherence tomography, fundus fluorescein angiography, and an RPE autofluorescence test were performed to observe the status of the transplanted simple RPE sheet.

Results. Mean follow-up duration was 24 ± 6 months. Mean ETDRS score increased from 14.0 ± 23.4 preoperatively to 31.9 ± 23.8 at 18 months postoperatively (P < 0.05). Of 14 eyes, 5 (36%) presented with central fixation postoperatively, whereas only 3 (21%) eyes presented with central fixation preoperatively. Ten grafts (71%) showed normal RPE color. Postoperative complications included one (7%) retinal detachment due to proliferative vitreoretinopathy and one (7%) delayed recurrent submacular hemorrhage.

Conclusions. Transplantation of an autologous simple RPE sheet for eyes with massive submacular hemorrhage associated with PED was achieved with a simplified surgical procedure, resulting in increased postoperative visual acuity.

Keywords: age-related macular degeneration, massive submacular hemorrhage, pigment epithelium detachment, polypoidal choroidal vasculopathy, simple RPE sheet transplantation, sub-RPE hemorrhage

Age-related macular degeneration (AMD) is the major cause of blindness in people older than 50 years in Western countries.1 The pooled prevalence from four Asian population estimates of early and late AMD is comparable to that reported for white populations.2 Furthermore, 54.7% of neovascular AMD (nAMD) patients in Japan have polypoidal choroidal vasculopathy (PCV).3 Patients with nAMD tend to run a more aggressive course and have a poor visual acuity (VA) outcome if left untreated.4 Massive submacular hemorrhages associated with pigment epithelium detachment (PED), which are regarded as fundus manifestations of hemorrhagic nAMD leading to poor visual prognosis, have not been included in any recent randomized controlled clinical trials to evaluate the efficacy of anti-VEGF medications through intravitreal injection,3 and intravitreal injection itself might be associated with the occurrence of RPE tears in selected cases.6 Roufail and Polkinghorne7 reported that functional outcomes of phacoemulsification and simple vitrectomy for the combination of cataracts and vitreous hemorrhage secondary to AMD are poor, the preexisting subretinal hemorrhage becomes more extensive after vitrectomy without subretinal management, and the incidence of surgical complications increases. Simple vitrectomy with intravitreal anti-VEGF medication achieves only short-term visual improvement in selected cases of vitreous hemorrhage associated with AMD and PCV.8 Recently, some modified surgical procedures were designed to rebuild the architecture and function of the submacular RPE layer with the recognition that the loss of RPE cells responsible for servicing the overlying photoreceptors leads to the gradual degeneration of nearby photoreceptors, resulting in retinal thinning and progressive visual impairment.9–11 Gradually, these surgical procedures were improved with better outcomes due to the development of advanced surgical tools and increased surgeon experience.12–15 Most of these surgical procedures to treat exudative AMD involve partial or full-thickness choroidal tissue transplantation with an overlying RPE layer after choroidal neovascular membrane (CNVM) excision. A large-scale choroidal incision during surgery, however, might increase the possibility of recurrent hemorrhage in the donor area and the subsequent occurrence of postoperative proliferative vitreoretinopathy (PVR). Therefore, the long learning curve and potential severe
postoperative complications are still major concerns for performing multicenter randomized controlled clinical trials to objectively evaluate the efficacy and safety of these surgical procedures.

Intact simple RPE grafts were successfully developed from the PED region outside the CNVM lesion for some patients during surgery for hemorrhagic AMD, and the grafts were demonstrated to contain only RPE basement membrane and an RPE monolayer with viable RPE cells and a positive apical junctional complex. We hypothesized that transplanting the autologous simple RPE graft from the PED area into the subfoveal RPE denuded region in the hemorrhagic eye would decrease the complexity of the surgical procedure, as well as postoperative PVR occurrence because the transplanted sheet is obtained directly from the PED region with the choroid left untouched. In addition, the simple RPE layer would allow the photoreceptors to receive nutrition more efficiently compared to a graft with partial or full-thickness choroidal tissue from the underlying choroidal vessels due to the thinness of the simple cell layer graft.

**METHODS**

At Peking University Eye Center, 14 consecutive eyes of 14 patients (six men and eight women) were enrolled in this study if they met all the following criteria: (1) simultaneous occurrence of massive submacular hemorrhage and PED; (2) increasing submacular hemorrhage over at least one temporal vessel arch, associated with a decline in vision; (3) submacular CNVM with subfoveal RPE loss confirmed during surgery; (4) ineligible for conventional treatments, including photocoagulation and photodynamic therapy due to the invisibility of CNVM shaded by thick subretinal and vitreous hemorrhage, or intravitreal injection of anti-VEGF medication could not control the massive subretinal hemorrhage; (5) best-corrected visual acuity (BCVA) better than light perception, but not better than 20/64; (6) length of time from the onset of submacular hemorrhage to operation shorter than 6 months; (7) medically fit for prolonged eye surgery and capable of fulfilling cohort follow-up examinations; and (8) no other retinal or macular abnormalities, such as retinal macular edema, diabetic retinopathy, retinal vein occlusion, or uveitis.

Submacular hemorrhage extending to at least one temporal vessel arch was defined as massive submacular hemorrhage. Patients with PCV and occult AMD were enrolled in the study. We use the term hemorrhagic AMD to include both the typical nAMD and PCV. A PCV diagnosis was based on indocyanine green (ICG) results showing polypoidal abnormalities along the border of the branching choroidal vascular network. Phacoemulsification was performed on 13 eyes; one patient with a clear lens was spared the cataract extraction. In all patients, we performed closed pars plana vitrectomy with four ports, hydraulic retinal detachment, 180° temporal peripheral retinotomy, and flipping of the retinal flap toward the nasal side of the optic disc. The gold bar applied in the previous report was also used to fix the flipped retina and to maintain a stable environment with the RPE layer exposed to the vitreous cavity. The details of these surgical procedures were previously reported. After the submacular lesion was completely excised, the detached RPE layer around the CNVM was excised by the presumed submacular site, it was then fixed into position by gently pressing the edge of the graft with the smooth back surface of the microforceps. Once most of the edges on the graft were flattened onto the underlying tissue, perfluorocarbon liquid (PFCL) was applied to fix the graft in place (Fig. 2).

When the free graft was fixed by PFCL, no more manipulation to the graft was attempted due to the fragility of the simple RPE layer. The retinal flap was then flipped back by reinserting the PFCL into the preretinal space while the subretinal PFCL was drained. Once the preretinal PFCL covered the macular region with the whole submacular graft tightly fixed, the subretinal PFCL was drained. A 360° endophotocoagulation was carried out on the peripheral retina with a scleral indenter. Silicon oil was exchanged and an intraocular lens was implanted. Silicon oil was removed approximately 3 months after the surgery. All operations were performed by one author (ZM).

Each patient was examined for BCVA using an Early Treatment Diabetic Retinopathy Study (ETDRS) chart. The printed panel chart was backlit with a luminance of 121.0 cd/m² measured with a digital light meter. All patients were required to read the chart from 2 m, starting at the top, until more than two letters were misread on a line. VA was assigned as the smallest line in which three of five letters were correctly identified. The method for measuring scores from an ETDRS chart was in accordance with the submacular surgery trial (SST) group. Snellen equivalent BCVA was also obtained for each patient from the ETDRS chart starting at 4 m. Counting fingers and hand motion were tested from 30 cm and considered equivalent to 20/1600 and 20/4000, respectively.

A 4-2 Goldmann III strategy was applied in the microperimetry (Nidek Technologies, Gamagori, Japan). Background illumination was set on 4 apostilb. Fundus images were while holding the free edge with a microforceps. An assistant illuminated this bimanual procedure through the inferior port. When the free graft was gently transpositioned to the presumed submacular site, it was then fixed into position by gently pressing the edge of the graft with the smooth back surface of the microforceps. Once most of the edges on the graft were flattened onto the underlying tissue, perfluorocarbon liquid (PFCL) was applied to fix the graft in place (Fig. 2).

Otherwise, the free graft could attach to the surface of the PFCL bubble and slip away from the submacular region. After the graft was fixed by PFCL, no more manipulation to the graft was attempted due to the fragility of the simple RPE layer. The retinal flap was then flipped back by reinserting the PFCL into the preretinal space while the subretinal PFCL was drained. Once the preretinal PFCL covered the macular region with the whole submacular graft tightly fixed, the subretinal PFCL was drained. A 360° endophotocoagulation was carried out on the peripheral retina with a scleral indenter. Silicon oil was exchanged and an intraocular lens was implanted. Silicon oil was removed approximately 3 months after the surgery. All operations were performed by one author (ZM).

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Autologous Simple RPE Sheet Transplantation

FIGURE 2. Picture taken after a free simple RPE layer was fixed to the submacular region by PFCL. □ represents the RPE denuded area. ★ represents the free graft. Scattered spots (black arrows) on the margin of the graft were RPE losses caused by the forceps pressing to stitch the graft onto the underlying tissue. The light spot is the reflection from the surface of the PFCL.

captured by a real-time infrared camera with a resolution of 768 × 576 pixels. Eyes with more than 25% fixation points located within a 4° diameter in the microperimetry were defined as eyes with central fixation. The recordings of the multifocal ERG (mERG), which reflected the summation potentials of cones and cone bipolar cells, were presented in hexagon-related single plots or in three-dimensional photographs. The stimulus array comprised 103 hexagonal elements. The recorded values were b-wave amplitude intensities (μV/square degree) within the central 5° of the retina. RPE autofluorescence, optical coherence tomography (OCT), fundus fluorescein angiography (FFA), and ICG tests were performed to detect the etiology of the disease before the surgery and to evaluate the status of the transplanted graft after the surgery. FFA and ICG were performed using a confocal scanning laser ophthalmoscope (Heidelberg Retina Angiograph, Heidelberg Engineering, Heidelberg, Germany). Autofluorescence was performed using the same Heidelberg Retina Angiograph. An argon blue laser (488 nm) was used for excitation. Emitted light was detected above 500 nm (barrier filter). To amplify the autofluorescence signal, 15 consecutive images were aligned and the mean image was calculated using image analysis software.

All 14 patients fully acknowledged the potential risks and all possible postoperative consequences before surgery. Written informed consent was obtained from each patient and his or her family members. This study was consistent with the 1964 Declaration of Helsinki and was approved by the ethics committee of the Medical Faculty of Peking University Third Hospital before applying this surgical procedure clinically.

Paired t-tests were applied to compare the difference between pre- and postoperative results with 95% confidence intervals (CIs) corresponding to the least significant difference, the results included ETDRS scores and b-wave amplitude of mfERG. Effectiveness was defined as significant if the probability of the respective tests was less than 0.05. The same CIs and effectiveness were also applied in the independent t-test to compare the different ETDRS scores between eyes with PCV and occult AMD pre- and postoperatively. Logistic regression analysis was used to evaluate the relationship between the status of central fixation and lesion size, age, duration of visual loss, and preoperative ETDRS scores. Lesion size was defined as the area of RPE loss observed during surgery. Pearson analysis was applied to analyze the correlation between preoperative VA and clinical features of the treated eyes, including simultaneous subretinal and sub-RPE hemorrhage, PED size, and vitreous hemorrhage. All analyses used the SAS program, version 10.0 (SAS, Cary, NC).

RESULTS

The preoperative clinical features of the 14 patients are shown in the Table. The median age was 65 and ranged from 48 to 80 years. Mean length of time from the occurrence of massive submacular hemorrhage to surgery was 38 ± 27 days. All 14 treated eyes presented with simultaneous massive submacular hemorrhage and PED, which was confirmed before surgery by OCT examination or during the operation by the direct observation of the surgeon (ZM); among the 7 eyes with large-scaled PED (larger than 3 disc diameters [DD]) observed during the surgery, 4 eyes presented with PED reaching the ora serrata. One patient (no. 13) had retinal detachment caused by severe subretinal hemorrhage. Before the occurrence of massive submacular hemorrhage, five eyes were diagnosed with occult CNVM and two eyes had PCV; the other seven eyes of seven patients had already presented with massive submacular hemorrhage of unknown etiology before they came to our eye center. The massive submacular hemorrhage occurred in nine eyes right after PDT (n = 4) and intravitreal injection of anti-VEGF medication (n = 5). The remaining five eyes were treatment-naïve before surgery.

The clinical data from this study are summarized in the Table. Mean follow-up duration was 24 ± 6 months. All patients completed 18 months of follow-up. Preoperative visual status was as follows: mean ETDRS score was 14.0 ± 23.4. Among the 14 eyes, 5 eyes had a VA of light perception, 4 eyes of hand motion, 3 eyes of counting fingers, and 4 eyes presented with VA better than 20/400. Among these four eyes, three eyes presented with central fixation.

At the 18-month follow-up, the mean ETDRS score (31.9 ± 23.8) was significantly improved compared with the preoperative mean ETDRS score (P < 0.05, Fig. 3). Snellen equivalent VA results at the 18-month follow-up revealed that nine eyes increased more than three lines, four eyes increased within three lines, and one eye decreased more than three lines. Of the 14 eyes, 11 presented a postoperative VA better than 20/400.

The five eyes with central fixation after surgery still had central fixation at the 18-month follow-up. Among these five eyes, three presented with no central fixation preoperatively, and two eyes had central fixation both before and after surgery. The macular retina with the underlying simple RPE graft was able to perceive light stimuli with increased VA in eight eyes at the 18-month follow-up microperimetry examination.

Normal RPE color of the graft was observed in 10 eyes by slit-lamp ophthalmic examination at the 18-month follow-up. The RPE denuded area around the graft appeared whitish grey in all eyes compared with the area with RPE cells (Figs. 4D, 5b, 6c). RPE autofluorescence (Fig. 5a) was detected in 10 grafts, one eye could not be examined for autofluorescence due to poor bilateral central fixation, and RPE autofluorescence could...
not be observed in 3 grafts after surgery. No leakage was
observed in the macular region with the underlying trans-
planted graft in the late stage of FFA, the background
fluorescence shaded by the graft (Figs. 4E, 6a) was observed
in 14 eyes; and the fluorescence of choroidal vasculature under
the transplanted graft appeared in 14 eyes by ICG examination
(Figs. 4E, 6b). Before surgery, OCT examination demonstrated
that two eyes presented with a PED with the absence of a
highly reflective line at the level of the RPE (Fig. 4B); the PEDs
of the other eyes could only be clearly detected during surgery
after the removal of vitreous and submacular hemorrhage.
Postoperative OCT examination revealed that the retinas of
the 14 eyes reattached well. No convex retina due to elevated
margin of the graft was detected in the macular area (Fig. 6d).
Mean amplitude of the mfERG b-wave was 47.67 ± 24.76 μV/
deg² preoperatively and 53.96 ± 18.98 μV/deg² postopera-
tively (P < 0.05). Submacular lesion specimens were obtained
from all 14 eyes; 8 specimens contained fibrovascular complex
membrane and the remaining 6 specimens appeared mainly to be
blood clots with an overlying RPE layer (Fig. 7).

Based on the preoperative angiography (FFA and ICG)
results, CNVM specimen analysis, and intrasurgery observation
of the submacular lesion, 10 eyes were diagnosed with occult
AMD and 4 eyes with PCV. The mean postoperative ETDRS
score of the four eyes with PCV was significantly increased
(27.5 ± 33.0 preoperatively versus 45.3 ± 31.4 postoperative-
ly; P < 0.05). The mean postoperative ETDRS score of the 10
eyes with occult CNVM was significantly increased (8.6 ± 17.8
preoperatively versus 27.4 ± 20.3 postoperatively; P < 0.05).
Although the mean ETDRS score of the 4 eyes with PCV was
better than that of the 10 eyes with occult AMD (P < 0.05)
before surgery, they were not statistically different after surgery
(P > 0.05).

The preoperative VA was statistically correlated with the
occurrence of both vitreous hemorrhage (P < 0.05, Pearson:
−0.62) and large-scaled PED (P < 0.05, Pearson: −0.57).
There was no statistical correlation, however, between preoperative
VA and other clinical features, including the location of
hemorrhage (solo subretinal hemorrhage or subretinal com-
bined with sub-RPE hemorrhage) or subtype of hemorrhagic
AMD (PCV or occult CNVM). A multifactor covariance model of
the status of postoperative central fixation revealed no
statistical relevance among age, VA loss duration, preoperative
ETDRS score, or size of RPE loss observed during surgery.

One case with preoperative central fixation resulted in
retinal detachment due to PVR 3 months after the original
surgery, and underwent another surgery with no central
fixation detected at the final follow-up. One eye presented
delayed submacular hemorrhage 10 months after silicon oil
removal and the subretinal blood disappeared after intravitre-
ous injection of anti-VEGF medication. One eye with cystoid
macular edema and three eyes with epiretinal membrane were
detected at the final follow-up by OCT examination.

**DISCUSSION**

In the present study, we successfully captured a simple RPE
sheet from the PED region outside the CNVM lesion in 14 AMD
eyes with massive submacular hemorrhage associated with
PEDs, and transplanted the grafts into a subfoveal RPE denuded
region. The clinical data of the 18-month postoperative follow-
up indicated that the simple RPE graft may preserve some
macular function with increased postoperative VA (Figs. 4C, 6c).
The patients in this study were not eligible for routine
treatment, such as PDT, intravitreal injection of anti-VEGF
medication, or simple vitrectomy with pneumatic displace-
ment. Four eyes with occult CNVM had massive subretinal

\[ \text{ETDRS} = \frac{100}{20} \times \left( \frac{V}{V_0} \right) \]

\[ \text{V/deg}^2 = \left( \frac{V}{\text{deg}^2} \right) \]

\[ \text{Amplitude} = \frac{\text{A}_{\text{b-wave}}}{\text{deg}^2} \]

\[ \text{ mfERG} = \frac{\text{b-wave}}{\text{deg}^2} \]

\[ \text{PED} = \frac{\text{macular area}}{\text{deg}^2} \]

\[ \text{VA} = \frac{\text{Snellen}^2}{\text{deg}^2} \]

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hemorrhage right after the PDT, and subretinal bleeding in five eyes in this study (including two occult CNVM and three PCV eyes) increased after intravitreal injection of anti-VEGF medication. All 10 specimens (10/14) diagnosed with occult AMD had fibrovascular tissue with blood clot attached, indicating that the disease had been present for some time. If simple vitrectomy were performed in these eyes without submacular CNVM management, the rate of recurrent sub-

**Figure 3.** Scatter graph shows the ETDRS scores before surgery compared with those of the final follow-up. Data points above the diagonal line indicate patients with improved visual acuity. ☒ represents eyes with PCV; ▲ represents eyes with occult CNVM.

**Figure 4.** Case 1 (patient no. 1) (A) Massive submacular hemorrhage and serosanguinous PED were observed. (B) OCT examination showed the presence of multiple PEDs with the absence of a highly reflective line at the level of the RPE before surgery. The preoperative examinations were all performed 15 days before the occurrence of breakthrough vitreous hemorrhage. (C) Stable central fixation was confirmed by microperimetry with sensitive light projection on the graft area (88% fovea tracking points within 4 degrees, reliability test: 1/8). (D) Postoperative fundus picture showing that the simple RPE graft (☉) had a brown color while the RPE denuded area (★) around it appeared whitish. (E) OCT examination showed that the retina and RPE graft attached closely, and the margin of the graft could not be detected by OCT examination due to the thinness of the RPE graft. Intraretinal cystoid macular degeneration was observed. (F) The postoperative ICG examination showed that the region covered by RPE cells (★) shaded the choroidal fluorescence while the RPE denuded area (☉) presented relatively hyperfluorescence, which originated from the choroid, and the choroidal vessels were observed through both the RPE covered area (★) and the RPE denuded region (☉), but with different definition.
macular hemorrhage caused by CNVM would be high. The surgical technique in this study tended to be useful for patients with thick submacular hemorrhage and subfoveal CNVM formation if the function of the foveal photoreceptor was preserved.

Objectively evaluating the viability of RPE cells on the graft was crucial in the process of evaluating the efficacy of transplantation of the simple RPE layer graft. Biomicroscopic examination provided an objective assessment of the transplanted graft; the brown color of the 10 grafts was consistent with the color of healthy RPE cells and indicated a viable graft (Figs. 4D, 5b, 6c). RPE autofluorescence examination provided additional evidence of the viability of the transplanted RPE graft, and the number of RPE autofluorescent-positive eyes (10 eyes) was the same as the number of eyes with a brown-colored graft. Perfusion of the choroidal vasculature underneath the graft is another key factor related to transplanted RPE graft survival. Choroidal hypofluorescence may appear after PDT, and subsequently cause macular retina ischemia. All 14 eyes in the present study, including 4 eyes treated by PDT before surgery, presented with positive choroidal vasculature underneath the transplanted simple RPE graft by ICG examination (Figs. 4E, 6a). The simple RPE sheet made the choroidal vascular easily visible, and the diffusion between the graft and the underlying choroidal tissue was not a concern in this study due to the thin simple RPE layer graft. Compared with the absolute scotoma in the RPE denuded area examined by microperimetry (Fig. 4C), light perception on the macula with the underlying graft (8/14) indicated possible interactions between macular photoreceptor cells and the transplanted RPE cells after surgery.

Figure 5. Case 2 (patient no. 5) (a) Autofluorescence examination showing the rectangle shape of autofluorescence on the macular area, which proved the integrity of the simple RPE graft, while the hypofluorescent area around the graft is the RPE denuded region. The hypofluorescent spots on the temporal side of the graft (arrows) were caused by forceps used to fix the graft onto the subfoveal region. (b) The fundus picture showed that the macular area with underlying simple RPE graft presented brown color, while the RPE denuded region appeared whitish. The subretinal scar (white arrow) originated from cauterizing the subfovea bleeding. Corresponding to the autofluorescence examination, the temporal side of the graft presented with depigmentation.

Figure 6. Case 3 (patient no. 13) (a) Postoperative FFA examination showed that the margin of the graft was hyperfluorescent. (b) ICG examination showed that both the simple RPE graft and the region covered with RPE cells around the papilla were hyperfluorescent (●) compared with the RPE denuded area (□) in the middle phase. (c) Microperimetry detected the functional retina on the free simple RPE graft. (d) OCT image showing the layered structure of the retina above the simple RPE graft. The graft was flattened with no convex formation of the retina above.
Both PCV and occult AMD have their own special characteristics. Emerging evidence, however, now suggests that PCV and nAMD may not be very different. For example, common molecular genetic determinants and environmental risk factors have been identified. It remains controversial as to whether PCV represents a subtype of nAMD. Therefore, the term hemorrhagic AMD was applied to include PCV and nAMD, both of which presented with massive submacular hemorrhage associated with PED in this study. Although PEDs did not usually occur in occult AMD compared with PCV, we found, however, that the PED expansion by sub-RPE injection was more easily achieved in eyes with PCV than in eyes with occult AMD, which might be related to different pathologic changes between occult AMD and PCV. The better preoperative ETDRS scores in eyes with PCV could be associated with less frequent subretinal fibrosis, whereas the specimens with fibrovascular membranes were more common in eyes with occult AMD (Fig. 7), so the metabolic exchange ability of photoreceptors might be more severely compromised in eyes with occult AMD due to its dense submacular lesion and long disease duration. A recurrent sub-RPE hemorrhage in the macular region occurred in a PCV eye (no. 11) 10 months after silicone oil removal, which might involve the characteristics of the PCV with a high incidence of polypoidal lesion recurrence and the surgery might not be directly related to the recurrent bleeding.

The major improvement of this modified surgical procedure compared with the others is the harvesting of a free simple RPE sheet from the PED area outside the CNVM lesion. The naturally produced PED adjacent to the inner collagenous layer of the Bruch’s membrane, and the RPE cells on the PED region exhibit preserved cellular viability and apical intercellular junctions. Therefore, we transplanted a simple RPE sheet instead of RPE-Bruch’s membrane complex to treat eyes with hemorrhagic AMD when a simple RPE sheet could be captured from the PED area during surgery. The advantages of applying a simple RPE sheet are as follows: (1) the procedure of capturing the transplanted RPE sheet is simplified, because the graft could be captured directly from naturally detached RPE layer; (2) a choroidal incision was avoided; the other procedures for capturing RPE grafts for transplantation require a choroidal incision, which potentially results in delayed bleeding from choroidal donor area and can cause photoreceptor damage; and (3) the transplanted simple RPE sheet is thin, which makes the whole retina, especially the macular retina, flattened postoperatively (Fig. 6d), while an apparent submacular convex appearance is sometimes caused by thick RPE-choroid graft, and this subretinal dysregularity might be one of the risk factors for the PVR occurrence in a long-term follow-up.

The present study was a retrospective observational case series without a control group; therefore, any conclusions should be appropriately restricted within a certain range. Due to the limited case samples, we were unable to draw meaningful conclusions regarding specific disease characteristics, such as age, VA loss duration, occurrence of vitreous hemorrhage, or size of RPE loss that would predispose to the status of postoperative central fixation. We believe that with the development of advanced surgical instruments, it would be possible to obtain an intact sheet of simple RPE layer from a healthy RPE area without PED, so the indications for this surgery could be expanded to benefit more patients.

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References
Autologous Simple RPE Sheet Transplantation


