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Autologous Neurosensory Retinal Transplantation for Refractory Large Macular Hole

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Abstract

Background: Management of a refractory chronic large macular hole represents a surgical challenge. The aim is to report the morphological and functional outcomes of autologous neurosensory retinal free flap transplantation for refractory large macular hole and macular hole related rhegmatogenous retinal detachment.

Methods: In this brief report, we enrolled case series of 5 patients with refractory large macular holes. Two patients had retinal detachment related to a myopic macular hole. A neurosensory retinal free flap graft was harvested outside the vascular arcades and placed either epiretinally or subretinally under the edges of the hole. Silicone oil was used as endotamponade in all cases and was removed 3-6 months postoperatively. Main outcome measures, including closure of the macular hole, change in best-corrected visual acuity, and alignment of neurosensory layers on OCT were recorded.

Results: There were 3 male and 2 female patients with a mean age of 69.6 (range 60–76) years. The mean follow-up was 29.2 months (range 19–53 months). Surgery resulted in the anatomical closure of the macular hole in all cases. In two cases with retinal detachment, the retina had remained attached in the postoperative follow-up. Different extent of functional improvement was achieved in all cases. Highest improvement of 4 lines in Snellen charts was recorded in a patient with a large myopic chronic macular hole. The OCT showed structural integration of the transplant in all cases. There were no intra- or postoperative complications.

Conclusion: Autologous neurosensory retinal transplantation can be an effective treatment for the closing of large refractory macular holes and macular hole-related retinal detachments. The procedure is safe and provides good anatomical result. Visual acuity improved in all cases.

Keywords: Autologous neurosensory retinal transplantation, chronic large macular hole, pars plana vitrectomy.

Brief Report

Macular hole (MH) is a full thickness break in the central part of the neurosensory central fovea, which causes poor vision and metamorphopsia.[1,2] It occurs most commonly in the 6th–7th decade of life and, more often, affects women than men.[3] Its reported prevalence is 0.2–3.3 per 1000 persons.[4] There are different etiologies that can lead to MH; it can be idiopathic or secondary, and is caused by trauma, chronic cystoid macular edema, or vascular occlusion.[3,5] Gass and Johnson described the clinical staging and the evolution of idiopathic MH.[1,2] Antero-posterior and tangential vitreous traction on the fovea can result in morphological changes that start with a macular cyst (stage 1 MH) and continue to a full thickness MH smaller than 400 μm (stage 2 MH). Further development results in stage 3 MH (greater than 400 μm in size and incomplete vitreous separation), and end with stage 4 MH, in which complete separation of the vitreous from the macula and the optic disk occurs.[1,2] In MH stage 4, frequent epiretinal membrane development has been found.[1,2,6]

Since its first description by Kelly and Wendell, the surgical management of MH by pars plana vitrectomy and associated surgical techniques has been improved. Different types of surgery for the treatment of chronic MH exists consisting of vitrectomy (to obtain a complete posterior vitreous detachment),[7] vitrectomy with peeling of the internal limiting membrane (ILM),[8] and vitrectomy with inverted ILM flap or temporal flap technique.[9]

Modern vitrectomy with different techniques of ILM peeling provides 95–98% closure rate of idiopathic MH.[7–9] On the other hand, treatment of patients with chronic large MH, patients with MH related to high myopia, or after trauma, represent challenging cases and may require multiple surgeries in order to achieve closure.[10] In comparison to fresh idiopathic MHs, which have a higher closure rate,[11–14] the postoperative (type 1) closure rate for large chronic MHs is lower (83.7%).[15] Surgical approaches for refractory MHs, after previous vitrectomy with ILM peel, are limited. The reported surgical methods are repeated vitrectomy,[16] laser photocoagulation combined with gas tamponade,[17] a simple gas tamponade,[18] an expanded ILM stripping,[19] and autologous ILM flaps.[20] If extensive ILM peeling were previously performed, harvesting a new suitable ILM free flap could be difficult. In those cases, lens capsular flap transplantation may be a solution,[21] but not in phakic eyes or pseudophakic eyes with previously performed posterior capsulorhexis. Autologous neurosensory retinal free-flap transplantation has been reported as an alternative surgical approach in cases of refractory MHs that underwent multiple surgeries and had no useful remnant ILM.[22] Alternatively, Rizzo et al. showed good anatomical results in closing large chronic MHs and retinal detachments with posterior MHs by using an amniotic graft.[23]

We retrospectively analyzed five cases of patients with chronic large, unclosed MH. There were 3 male and 2 female patients observed. Two cases were with rhegmatogenous retinal detachment related to MH. The mean age of patients was 69.6 years (range 60–76 years). In all cases, we performed pars plana vitrectomy with autologous neurosensory free flap retinal transplantation and silicon oil tamponade. A neurosensory retinal free flap was harvested outside the vascular arcades. The graft was placed either epiretinally or subretinally under the edges of the hole. Silicone oil was removed 3-6 months postoperatively in all cases. The mean follow-up time was 29.2 months (range 19–53 months). Our case series showed complete closure of the hole in all five patients (Table 1). In cases with retinal detachment, the retina remained attached in the postoperative period after silicone oil removal. Visual acuity improved in all cases (Table 1). Patients gained visual acuity from 1 to 4 lines in Snellen charts. The highest improvement of 4 lines in the Snellen charts was recorded in a patient with a large myopic chronic macular hole. The OCT showed complete integration of the retinal transplant into the retinal structures in all cases (Figure 1). There were no intra- or postoperative complications.

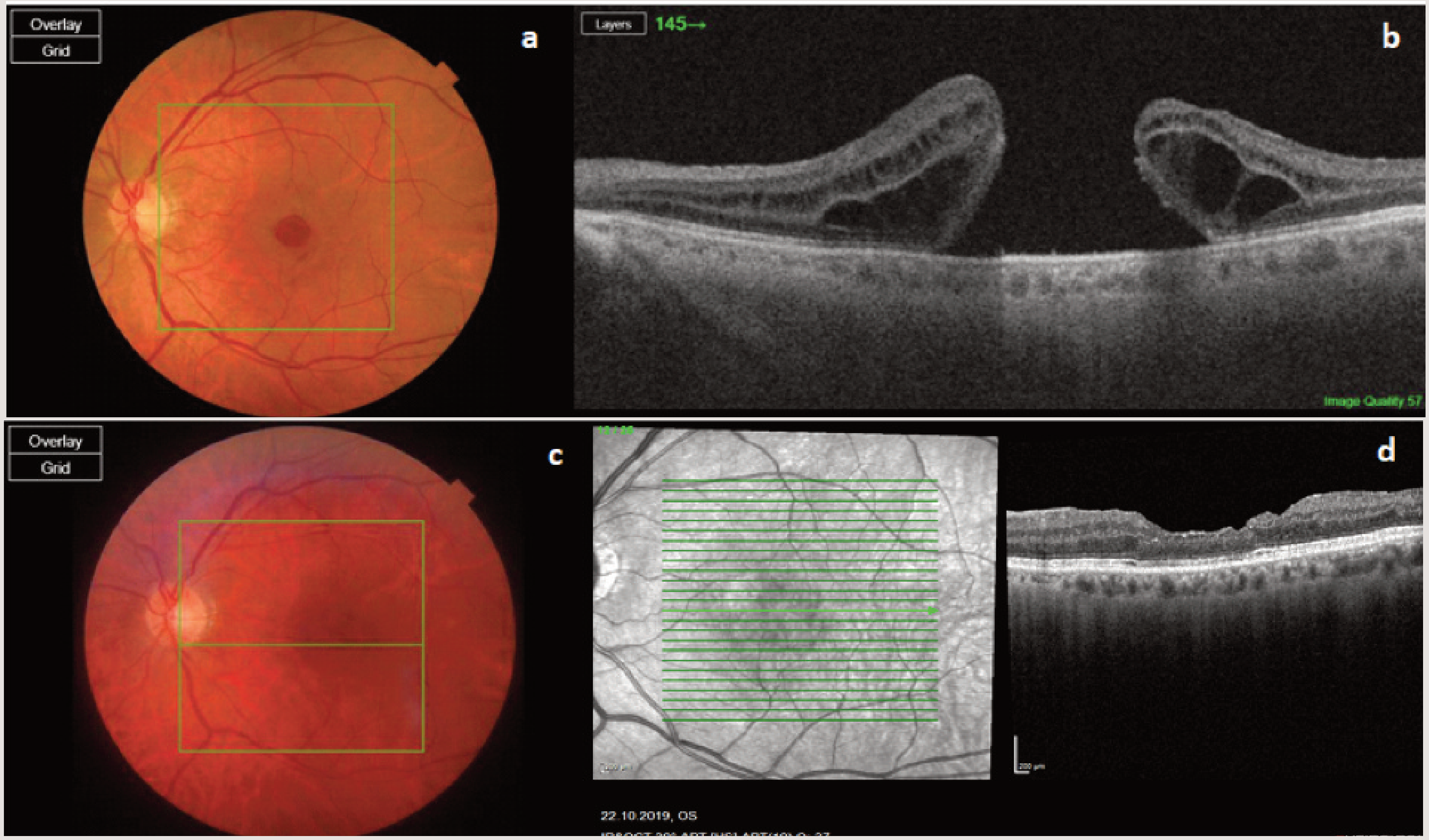

Figure 1. *Photo of the fundus and OCT findings in patient with autologous neurosensory free-flap retinal transplantation: a. preoperative fundus photo of the left eye showing large macular hole; b. preoperative OCT scan of the same eye showing large macular hole with elevated edges; c. postoperative fundus photo of the same eye; d. postoperative OCT scan showing closed macular hole with structural integration of the graft.*

	Case 1	Case 2	Case 3	Case 4	Case 5
Age (years)	68	60	69	76	75
Gender	male	male	male	male	female
Closure of macular hole	complete	complete	complete	complete	complete
Follow-up duration	53 months	28 months	22 months	19 months	24 months
Preoperative BCVA	0.1	HM	0.05	0.1	HM
BCVA at last follow-up	0.2	0.2	0.16	0,5 p	0.03

Table 1. *Patients' characteristics.*
Legend: *BCVA-best corrected visual acuity.*

Vitrectomy with the transplantation of autologous neurosensory retinal free flap can be an effective addition to the surgical options for large chronic MHs with or without retinal detachment, even after failed surgery with ILM removal or transplantation. All grafts showed long-term viability, reperfusion, and structural integration regardless of whether the edges were placed epiretinally or subretinally, although the best anatomical results were obtained when the transplant was laid under the edges of the surrounding retina. The OCT revealed clear anatomical improvement with the reappearance of an ellipsoid zone associated with improvement of visual function according to visual acuity testing.

The question to be answered in the future remains whether and to what extent the transplanted photoreceptors have the capacity to integrate and gain new functions in a new environment. Therefore, the possible potential of the transplanted neurosensory retinal graft for the creation of functional neural connectivity with the adjacent retina remains to be elucidated after a longer follow-up period.

Further studies on a larger number of patients are needed. It is necessary to define more clearly for which category of patients this approach is most appropriate and for which patients it represents the method of choice wherein the best functional outcome would be expected.

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