ANATOMICAL AND VISUAL OUTCOMES AFTER TWO-PORT PARS PLANA VITRECTOMY REOPERATION UNDER SILICONE OIL FOR EPIMACULAR MEMBRANE OR RECURRENT RETINAL DETACHMENT

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Purpose: To describe the anatomical and visual outcomes in a series of patients undergoing two-port pars plana vitrectomy reoperation under silicone oil for recurrent retinal detachment (RD) due to proliferative vitreoretinopathy or epimacular membrane (EMM) after RD repair.

Methods: This study is a prospective, consecutive, interventional case series of patients presenting with recurrent RD or EMM under silicone oil. Two-port 25-gauge pars plana vitrectomy reoperation without an infusion port was performed in all cases.

Results: Thirty-nine patients were included. Reoperation pathology included recurrent RD with proliferative vitreoretinopathy (n = 33) and EMM alone (n = 6). The mean number of previous retinal surgeries was 2.4 ± 1.1 (range, 1–5). The mean overall follow-up was 24 ± 3.7 months. The mean visual acuity change from baseline at final follow-up was an improvement of 0.74 ± 0.63. Macular reattachment was achieved in 29 of 33 patients with RD, and EMMs were successfully removed in all patients.

Conclusion: Two-port pars plana vitrectomy reoperation is an efficacious method for repair of consecutive RD due to proliferative vitreoretinopathy or EMM in patients with previous RD repair with silicone oil. Significant visual improvement with a low complication rate may be achieved in patients with advanced proliferative vitreoretinopathy or EMM under silicone oil.

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Retinal detachment (RD) repair has undergone significant advances in the past several decades with the continuous development of novel tools and techniques to improve surgical success rates. Currently, pars plana vitrectomy, with or without scleral buckle or with scleral buckle alone, demonstrate an excellent primary reattachment rate of more than 90%.[1] Nevertheless, up to 10% of cases require additional surgery because of surgical failure secondary to proliferative vitreoretinopathy (PVR)[2,3] or additional pathology such as epimacular membrane (EMM).[4,5]

Proliferative vitreoretinopathy or cicatricial changes involving the retina or vitreoretinal interface complicates up to 10% of RDs during the course of treatment[1,2,6] and is the primary reason for initial surgical failure.[1–3] There is a paucity of data regarding the management strategy and course of the minority of patients who eventually require multiple surgeries for

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RD with PVR[5,7]; however, silicone oil (SO) endotamponade is frequently present, and eventual inoperability is determined in 3% to 8% of cases.[3] The need for retinectomy[8] and the presence of a scleral buckle[3] at any portion in the course of PVR treatment have recently been reported to be potentially associated with a worse final visual outcome.

Consecutive EMM complicates up to 12% of RD repairs, regardless of the surgical technique used.[4,9–12] Typically, a remove-and-replace approach is used when such cases undergo further attempts at surgical repair, or the SO is removed at the time of EMM removal.[13] Charles developed the technique of operating under SO[14–16] and has described this method for performing reoperations for recurrent PVR and EMM. Recently, an infusion-free two-port vitrectomy revision technique in which surgical tasks are performed under indwelling oil has been described.[15,17,18] Additional two-port techniques with a typical balanced salt solution infusion have been described.[19–21] The purpose of this study was to describe the anatomical and visual outcomes in a consecutive series of patients with recurrent RD due to advanced PVR or EMM (macular PVR) treated with 2-port 25-gauge pars plana vitrectomy reoperation, in which all surgical tasks were performed under indwelling SO.

Methods

This prospective, consecutive, interventional case series was performed over a 3-year study period from February 2010 to February 2013. All patients were seen and examined by an experienced vitreoretinal specialist at Charles Retina Institute, Memphis, TN. All patients had vitrectomy reoperation during the initial 6 months of the study period, and follow-up data were collected for at least 18 months after the procedure. The treatment of all patients and data conformed to the tenets set forth in the Declaration of Helsinki and was performed in accordance with the Health Insurance Portability and Accountability Act of 1996. The study was exempt from institutional review board approval as an observational variation of a standard surgical technique.

Consecutive patients were considered for inclusion only after meeting the following inclusion criteria:

1. Previous rhegmatogenous RD repair with SO endotamponade.
2. The presence of recurrent RD due to Grade C or greater PVR according to the Retina Society Classification[22,23] or EMM under SO.
3. No history of additional eye disease other than history of cataract extraction or RD repair.

Surgical Technique

All operative procedures were performed by one of the two surgeons, S. Charles or J. I. Calzada. A 25-gauge pars plana vitrectomy (Alcon Laboratories, Fort Worth, TX) reoperation was performed in all cases. Two ports were initially placed superotemporal and superonasal at a position of 3 mm posterior to the limbus; however, no third port/infusion line was placed. Nonvalved cannulas and standard endoillumination were used in all cases. For cases with subretinal fluid, alternating SO infusion was performed with a viscous fluid controller in conjunction with sequential internal drainage of subretinal fluid, either through an existing retinal break or through a drainage retinotomy. Where subretinal fluid was present in the posterior pole, a small drainage retinotomy was created with 25-gauge endodiathermy, just peripheral to the vascular arcades, and internal drainage of subretinal fluid was performed. The microvitrector or soft-tip cannula was used for internal drainage of subretinal fluid. Thousand-centistoke SO (Silikon 1000; Alcon Laboratories) was used for sequential infusion in all cases, regardless of the preoperative indwelling oil viscosity. In many cases, emulsification was present in the anterior chamber and was removed by placing a 30-gauge needle on the extrusion system and aspirating through a limbal entry site.

All regions of epiretinal membrane or residual posterior vitreous cortex were removed with internal limiting membrane forceps. Internal limiting membrane stains or particulate marking was not performed. Removal of the internal limiting membrane was performed concurrent with or after the removal of EMM, but it was avoided in cases without macular PVR. Subretinal PVR membranes were removed when within the posterior pole or when believed to be contributing to the RD. This was achieved by creating a punch-through retinotomy with end-grasping forceps and sequential subretinal PVR removal. Anterior loop traction was removed with the microvitrector. Subsequent endophotocoagulation was applied to all patent retinal breaks.

Retinectomy was performed after initially cauterizing large vessels at the posterior border of the planned retinectomy site. Silicone oil was infused if a slight overfill was not present. Retinectomy was then performed with the microvitrector, conformal to the retinectomy in central peripheral direction. Alternating SO injection and retinectomy were performed to maintain intraocular pressure in the high-to-normal range.

Data Analysis

Patient demographics and clinical variables were recorded and analyzed. For low vision measurements,

Table 1. Baseline Characteristics of Patients Undergoing 2-Port Vitrectomy Reoperation Under SO*

Preoperative PVR Extent†	n	Mean Age, years	Disease Duration, months	Subretinal PVR	Mean BCVA
C-1	7	39 ± 24	12.6 ± 5.1	3	2.19 ± 0.18
C-2	16	48 ± 23	10.4 ± 4.4	6	2.23 ± 0.17
C-3	7	55 ± 22	8.8 ± 3.2	2	2.21 ± 0.35
D	3	32 ± 20	14.6 ± 5.3	1	2.33 ± 0.31
Macular PVR	6	33 ± 18	9.2 ± 4.1	1	2.28 ± 1.5

Data presented as mean ± standard deviation.
*BCVA, Snellen best-corrected visual acuity converted to log of the minimum angle of resolution; n, number of patients.
†PVR extent using the Retina Society Classification; macular PVR denotes EMM under SO after rhegmatogenous RD repair.

a modified Freiburg acuity testing scale[24] was used to convert Snellen visual acuity to log of the minimum angle of resolution (counting fingers only = 1.8, hand motion = 2.3, light perception = 2.7, and no light perception = 3.0). The initial and final best-corrected visual acuity (BCVA) was recorded, and visual change was calculated. Because of the complex nature of the rare phenomenon analyzed, no a priori power calculation was performed. Disease duration was calculated as the time since the initial RD presentation in months. Three diagnostic categories included recurrent RD due to extramacular PVR with or without patent retinal breaks, macular PVR (EMM) alone, or both macular PVR and recurrent RD. Logistic regression was used to evaluate the effect of categorical variables on visual outcome. A linear multivariate model was constructed, including age, preoperative BCVA, final BCVA, and the number of previous surgeries.

Results

Thirty-nine consecutive patients were included consisting of 19 women and 20 men. The mean age was 44 ± 23 years. Patient ethnicity included 29 whites, 7 African Americans, 2 Hispanic, and 1 Indian. Baseline clinical characteristics and RD extent are summarized in Table 1. Mean overall follow-up time was 24 ± 3.7 months. All patients had a history of fovea involved RD. Those with recurrent RD had macular detachment preoperatively. The mean overall preoperative BCVA was 2.23 ± 0.21. The mean BCVA change was an improvement of 0.74 ± 0.63, and the mean BCVA at the final follow-up was 1.51 ± 0.71. Disease duration ranged from 4 months to 26 months (mean, 9.4 ± 4.4 months) and was inversely correlated with the BCVA at the final follow-up through bivariate analysis ($P = 0.023$). The mean number of previous retinal surgeries was 2.4 ± 1.1 (range, 1–5). The number of previous surgeries was associated with decreased visual outcome ($P = 0.002$) and decreased improvement in the BCVA ($P = 0.007$) through bivariate regression. Visual characteristics and outcomes by retinal pathology category are presented in Table 2. There were no significant differences in preoperative ($P = 0.197$), final ($P = 0.386$), or change ($P = 0.211$) in the BCVA among diagnosis categories.

Complications observed throughout this study period included emulsification-induced elevated intraocular pressure, presence of SO in the anterior chamber, and persistent subretinal fluid. Conversion to a traditional remove-and-replace technique was not required in the present series. We did not observe residual EMM throughout the study period. Emulsification-induced elevated intraocular pressure was present in 12 patients preoperatively and 2 patients during the postoperative period. Emulsification was present in 26 patients, in which all of them had all visible emulsification removed from the anterior chamber intraoperatively. Residual subretinal fluid was present in 13 patients; however, the macula was reattached in all but 4 patients, representing 88% of those with RD preoperatively. Typical appearance 1 day preoperatively and 1 day postoperatively are

Table 2. Visual Characteristics by Preoperative Pathology in Patients Undergoing 2-Port Vitrectomy Reoperation Under SO*

Retinal Pathology	Mean Preoperative BCVA	Mean Final BCVA	Mean BCVA Change	Mean Follow-up, months
RD (n = 23)	2.27 ± 0.22	1.58 ± 0.78	0.70 ± 0.13	25 ± 4.1
Macular PVR (n = 6)	2.28 ± 0.25	1.43 ± 0.43	1.15 ± 0.25	22 ± 1.3
RD + macular PVR (n = 10)	2.13 ± 0.19	1.44 ± 0.64	0.59 ± 0.21	25 ± 3.7

Data presented as mean ± standard deviation.
*RD due to PVR under SO; BCVA, best-corrected Snellen visual acuity converted to log of the minimum angle of resolution.

demonstrated in Figure 1. The four patients with persistent macular detachment at the final follow-up represented redetachment due to recurrent inferior PVR. Retinectomy was required in 14 patients, in which 4 of them represented the patients with persistent macular detachment. Requirement for retinectomy was not associated with the final visual outcome through logistic regression ($P = 0.249$). Subretinal SO was present in 3 cases, 2 of which were Grade C-3, and 1 was Grade D with posterior funnel due to macular and epipapillary PVR. Retinectomy resulted in the resolution of subretinal oil intraoperatively in these cases, and we did not observe postoperative subretinal oil during the study period. Intraoperative anterior chamber SO occurred in eight patients and was seen postoperatively in five patients. Three of five patients who developed intraoperative SO in the anterior chamber had SO in the anterior chamber during the postoperative period, all of them were aphakic. Preoperative lens status was phakic in 11 patients, pseudophakic in 21, and aphakic in 7. Nuclear sclerosis progression was present at the final follow-up in 6 of 11 patients during the study period, in which 4 of them underwent phacoemulsification with intraocular lens during the study period. The presence of a scleral buckle was not associated with BCVA outcome ($P = 0.578$) or BCVA change ($P = 0.688$).

In a multivariate model, age was found to be inversely associated with preoperative visual acuity ($P = 0.035$). Age was not, however, correlated with visual outcome ($P = 0.399$) or change ($P = 0.544$). Preoperative visual acuity was the only variable correlated with the final visual outcome ($P = 0.003$). Visual outcome was not correlated with the number of previous surgeries ($P = 0.229$).

Discussion

The results of the present series indicate that 25-gauge two-port pars plana vitrectomy reoperation is an efficacious method for repair of recurrent RD repair or EMM under previously placed SO. Advanced PVR and EMM under previously placed SO may present a particular challenge for both patient and surgeon. Many patients have required multiple previous eye surgeries,[25] and the rate of retinal redetachment after SO removal has been reported to be more than 10%.[19] Data from recent studies[1,3,25] of RD repair indicate that a consistent minority of patients develops the need for multiple surgical procedures and may progress to an eventual inoperable outcome. Nevertheless, anatomical and visual improvements were achieved in most patients in the present series. Previous reports

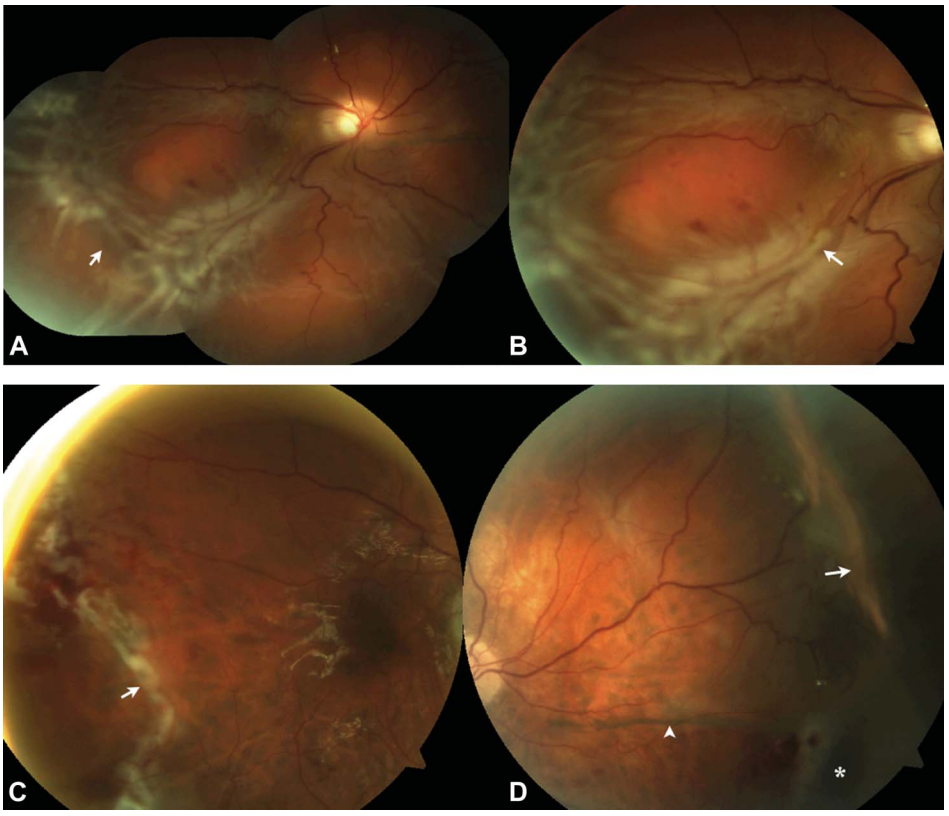

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Fig. 1. Perioperative images of a patient undergoing two-port pars plana vitrectomy reoperation for recurrent RD due to advanced PVR. **A.** Preoperative fundus photograph demonstrating a total RD under SO with previously placed encircling scleral buckle (arrow) and extensive PVR membranes; visual acuity is hand motion. **B.** Higher magnification preoperative fundus photograph of patient in **A** demonstrating PVR membranes (arrow). **C.** Appearance on postoperative Day 1 demonstrating temporal retinectomy with surrounding endophotocoagulation marks (arrow) and complete retinal reattachment; visual acuity is 20/80. **D.** Postoperative appearance nasal to the optic disk demonstrating retinal reattachment, scleral buckle (arrow), position of scleral buckle sleeve (asterisk), and subretinal PVR at the position of previous external drainage site (arrowhead).

have indicated that eyes with PVR[5] or EMM alone[13] have a relatively high rate of redetachment after SO removal.[13,19,26] However, there are few formal reports of visual and anatomical outcomes of recurrent RD or EMM under SO, regardless of surgical technique. The present series focused on patients with recurrent retinal pathology after multiple previous surgeries (mean, >2) that were still considered high risk for redetachment after SO removal.

The visual results demonstrate that even in the context of multiple previous attempts at RD repair, significant visual improvement is possible in patients with recurrent RD due to PVR or EMM under SO. Regardless of whether operative pathology included recurrent RD alone, EMM, or both, mean visual improvement was at least five lines of Snellen acuity. In fact, only eight patients failed to improve visual acuity by final follow-up, and two patients developed reduced vision that was thought to be at least in part due to SO-induced glaucoma. There is inherent difficulty in interpreting the visual significance, however, of improvement in the low-vision range. In the present series, the mean preoperative vision was hand motion only, and the mean postoperative vision improved to a range that included form recognition (mean, 20/600). This likely represents significant functional improvement, especially in monocular patients (6/39 in the present series). Considering the approximately 20% lifetime risk of RD in fellow eyes, improving to ambulatory vision in the worse eye may still represent a significant visual outcome.

Potential disadvantages of operating under SO include intraoperative migration of SO into the anterior chamber, concern regarding the inability of vitrectomy instruments to function within SO, and difficulties with intraoperative visualization. In contrast, we found that only a minority of cases involved the anterior chamber SO migration (8/39), less than half of which maintained SO in the anterior chamber in the postoperative period. In fact, we found that the migration of SO emulsification into the anterior chamber was advantageous for intraoperative removal through a limbal paracentesis. Nine of 12 patients with elevated intraocular pressure preoperatively due to emulsification normalized postoperatively. The presence of indwelling SO did not obscure visualization intraoperatively and in fact highlighted the borders of anterior loop traction and residual peripheral vitreous. The 25-gauge vitrectomy instruments functioned well in the present series under indwelling SO.

There are many theoretical advantages of performing surgical tasks under media that are immiscible in vitreous or infusion fluid. As previously reported,[14,16,18] surgical tasks, such as membrane peeling, retinectomy, internal drainage of subretinal fluid, and photocoagulation, are easily performed under the oil interface. Indwelling SO also provides constant surface tension management to areas of patent or potential retinal breaks. This prevents increased subretinal fluid that is only possible in the presence of infusion fluid. Silicone oil also provides viscous stabilization of retinal motion and may obviate the need for additional light sources or bimanual techniques. With the eye in operating position, a meniscus of aqueous, vitreous, or subretinal fluid is present posteriorly. Therefore, the microvitrector or other instruments may be placed beneath this interface and used with standard techniques. Although internal drainage of subretinal fluid is typically performed under air infusion, sequential SO injection with a viscous fluid controller was found to be an efficacious method for vitreous cavity volume replacement, similar to previous reports.[17,18]

The present series remains limited by single center location, relatively small sample size, and the lack of a control group in which a remove-and-replace technique was used. There remains inherent difficulty in assessing visual improvement in patients who remain in the low-vision range. Nevertheless, we conclude that two-port reoperation under SO is an efficacious method for repair of recurrent RD due to PVR or EMM. Significant visual and anatomical improvements with few complications are possible in patients with a clinical scenario that typically portends a poor visual prognosis.

Key words: epimacular membrane, epiretinal membrane, macular PVR, pars plana vitrectomy, retinal detachment, proliferative vitreoretinopathy, silicone oil, two-port vitrectomy.

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