

# Subretinal Perfluorocarbon Liquid for Dissection of Proliferative Vitreoretinopathy

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Proliferative vitreoretinopathy (PVR) is a frequent condition following complex retinal detachments or trauma, and subretinal PVR is a common cause of retinal redetachment. Subretinal PVR removal is challenging and may require creating multiple or large retinotomies, making manipulation of the retina difficult and sometimes hazardous. We propose a novel surgical technique that may facilitate subretinal removal of PVR. After peripheral retinotomy of 180 degrees or greater, perfluorocarbon liquid (PFCL) is carefully introduced into the subretinal space as a single bubble which provides space to perform the maneuvers. The PFCL serves as a second hand which folds the retina over, thereby allowing better visualization for safer and easier subretinal PVR removal. PFCL is then removed by direct aspiration as a single bubble while still under balanced salt solution, taking advantage of its high surface tension which prevents leaving bubbles behind. The described technique allows adequate exposure of the subretinal space for proper dissection of difficult-to-reach subretinal PVR. We applied this technique in five patients with chronic retinal detachment, extensive subretinal PVR and poor visual potential. The utilization of subretinal PFCL can assist dissection of subretinal PVR and may be useful in eyes with complicated retinal detachment and poor visual prognosis.

**Keywords:** Proliferative Vitreoretinopathy; Retinal Detachment; Perfluorocarbon Liquids

*J Ophthalmic Vis Res* 2012; 7 (4): 350-354.

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**Received:** April 15, 2012

**Accepted:** July 23, 2012

## INTRODUCTION

Severe proliferative vitreoretinopathy (PVR) is a common problem following complex retinal detachments and trauma. Current instruments facilitate removal of epiretinal membranes during vitrectomy in order to achieve retinal reattachment. Unfortunately, removal of subretinal PVR is often mandatory but not easily achieved; this requires multiple posterior retinotomies and inability to completely remove these membranes may hinder retinal reattachment. Removal of subretinal PVR often

results in formation of new breaks, enlargement of retinotomies and traction on the vitreous base.<sup>1,2</sup>

Perfluorocarbon liquids (PFCLs) are employed to stabilize the retina during vitrectomy working as a "second hand" in epiretinal PVR dissection and also to drain subretinal fluid through peripheral retinal breaks. Immiscibility with water, high specific weight and high surface tension have made PFCLs an invaluable tool in vitreoretinal procedures.<sup>3,4</sup>

Herein, we report the use of subretinal PFCLs in conjunction with large peripheral

retinotomies for thorough removal of subretinal PVR to achieve better reattachment rates.

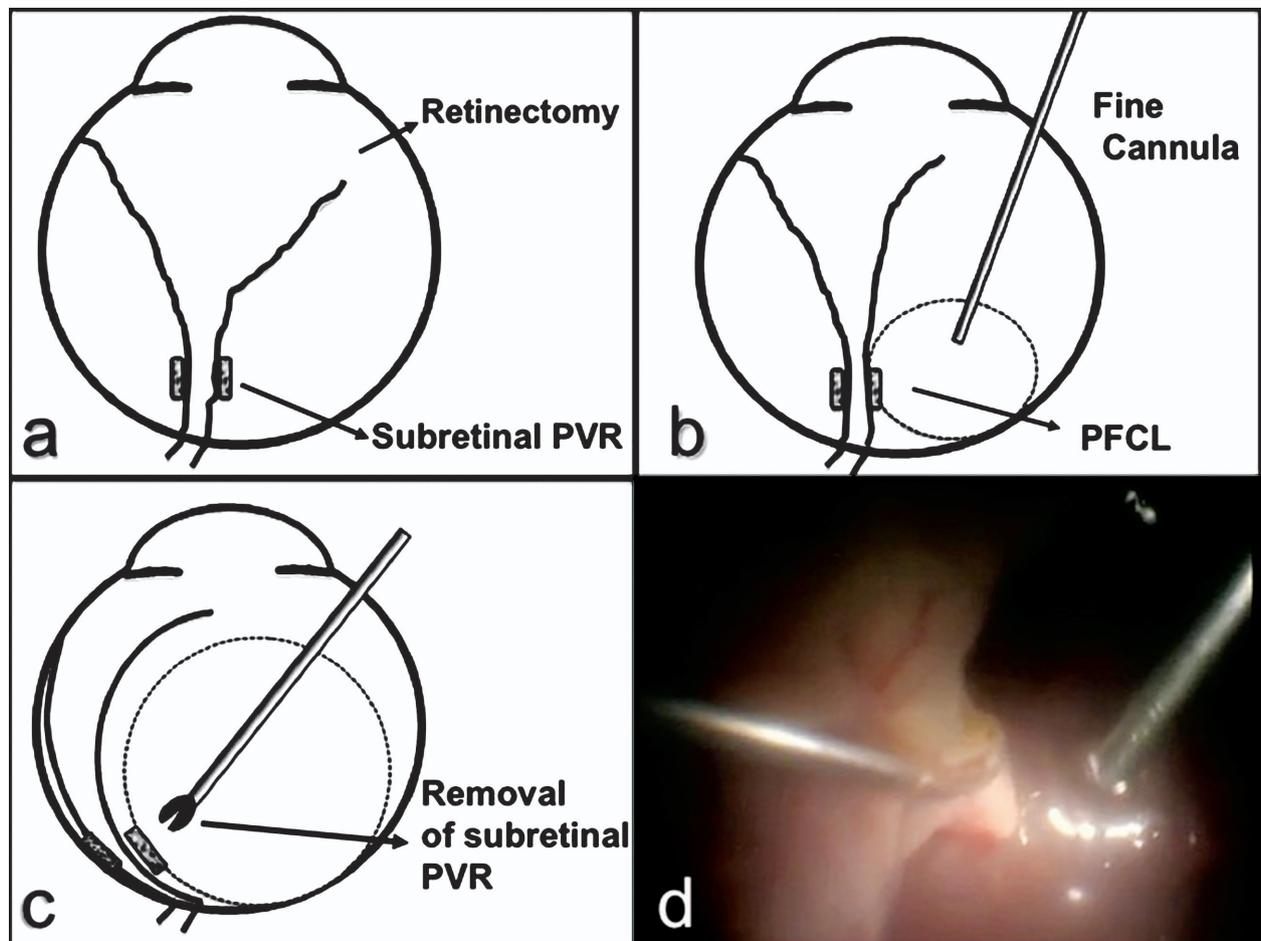
**SURGICAL TECHNIQUE**

Approval was obtained from the Ethics Committee of the Asociación para Evitar la Ceguera en México (Hospital “Dr. Luis Sánchez Bulnes”). All procedures followed the tenets of the Declaration of Helsinki; written informed consent was obtained from all participants prior to the procedure.

In complicated retinal detachment and extensive PVR cases, it is of utmost importance to perform a complete vitrectomy together with

total posterior vitreous detachment, posterior hyaloid removal and thorough dissection of all epiretinal proliferative tissues. Whenever the retina is not mobile enough to be easily reattached, the need for subretinal PVR dissection through retinotomies or retinectomies should be considered.

We propose that in the presence of extensive subretinal PVR, a peripheral retinotomy can be performed according to the location of PVR to be dissected. The retinotomy should be at least 180 degrees in extent, however larger dissection is sometimes required (Fig. 1a). Perfluorocarbon liquids are then placed through the retinotomy as a single bubble in the subretinal space using



**Figure 1.** (a) Peripheral retinotomy is performed according to the location of proliferative vitreoretinopathy (PVR) to be dissected and should be at least 180 degrees in extent. (b) Perfluorocarbon liquid (PFCL) is injected as a single bubble in the subretinal space using a fine cannula in order to fold the retina to the contralateral side. With this maneuver, access to the subretinal space is gained and bare retinal pigment epithelium (RPE) on one side, and the external neuroretinal surface on the other side become visible. (c) Subretinal PVR can now be removed using forceps or picks while PFCL is holding the retina folded over, avoiding further retinal damage. (d) PVR dissection can be performed with forceps or employing a bimanual technique using a chandelier.

a fine cannula. This should be done while gently holding the retina attached to the ora serrata using the light probe or another instrument. This maneuver allows the retina to fold over toward the contralateral side. Care should be taken not to fold the retina over the fovea in order to avoid photoreceptor disruption. With this procedure, access is provided to the subretinal space enabling the surgeon to visualize bare RPE on one side, and the external neuroretinal surface on the other (Fig. 1b). PVR may be removed using vitreous forceps or picks at this step (Fig. 1c). Peripapillary “napkin-ring” subretinal PVR is easily accessible (Fig. 1d). Once PVR removal is completed, PFCLs are removed by direct aspiration as a single bubble while still under balanced salt solution (BSS) taking advantage of their high surface tension which prevents leaving bubbles behind. Once the retina is folded back in place, PFCLs may be used over the retina for reattachment. Laser photocoagulation is applied at the border of the retinotomy followed by air-fluid exchange and finally silicone oil tamponade.

The current report includes five eyes of five patients with retinal detachment secondary to trauma of more than 6 weeks’ duration who presented with PVR grade C. The retina remained attached in all eyes after surgery over a mean follow-up period of one year. One eye developed PFCL subretinal droplets at the equator. No signs of abnormal inflammation or proliferation of fibrous tissue were noted. Despite chronicity, severity and poor visual prognosis of the detachments, all eyes maintained their preoperative vision or showed a modest increase (Table 1).

**Table 1.** Clinical outcomes one year after surgery using subretinal perfluorocarbon liquids for dissecting proliferative vitreoretinopathy

Patient	Initial BCVA	RD Duration	BCVA at 6 weeks	Retinal Status
1	CF	4 months	20/400	Attached
2	HM	2 months	CF	Attached
3	20/400	6 weeks	20/400	Attached
4	HM	6 weeks	20/300	Attached
5	CF	4 months	CF	Attached

BCVA, best corrected visual acuity; RD, retinal detachment CF, counting fingers; HM, hand motions

## DISCUSSION

Subretinal PVR has long been known to hinder retinal reattachment in spite of adequate epiretinal membrane dissection, nonetheless not all subretinal membranes require removal. Surgical manipulation in the submacular space may lead to photoreceptor loss and could have been the cause of disappointing visual outcomes in previous studies on surgical removal of submacular neovascularization.<sup>5</sup>

Several techniques have been described for patients requiring subretinal PVR excision for retinal reattachment. Most techniques involve appropriately placed retinotomies together with dissection or removal by traction, of subretinal bands. However, these maneuvers may cause further damage to the retina. Furthermore, multiple posterior retinotomies are usually necessary and retinal tears or retinotomies may become enlarged when traction is exerted on the membranes. These unwanted complications may be reduced by employing small retinotomies, however this advantage is offset by decreased maneuverability and limited access to subretinal membranes.

The repair of complicated retinal detachments with anterior and subretinal PVR often requires large peripheral retinectomies in order to loosen the retina to a degree that allows its reattachment. These retinectomies may be used to gain access to the subretinal space. Unfortunately, the mobilized retina often gets in the way, obscuring visualization and making dissection difficult.

The technique we propose herein permits adequate visualization as well as stabilization of the retina thereby allowing thorough dissection of subretinal membranes. It can be performed with the aid of a chandelier making bimanual dissection easier; this might prevent iatrogenic retinal tears since it significantly diminishes retinal traction. Moreover, PFCLs provide more space to maneuver and may prevent damage to the RPE, Bruch’s membrane and choriocapillaris. Alterations of these structures due to lack of adequate space have been reported as complications of submacular surgery.<sup>6</sup>

PFCLs have become an indispensable tool

in modern vitreoretinal surgery. The presence of these liquids in the subretinal space is usually considered a transoperative complication which occurs in eyes with persistent retinal traction and open retinal breaks.<sup>7</sup> The use of PFCLs in the subretinal space may raise questions regarding its toxicity. *In vivo*, subretinal PFCL droplets produce measurable scotomas and alter retinal function.<sup>8</sup> *In vitro*, PFCLs left for long periods in the vitreous cavity provoke photoreceptor disruption, external and internal plexiform layer thinning, decrease in the number of ganglion cells and damage to the inner nuclear layer, in addition to edema and macrophage infiltration into superficial layers.<sup>9</sup> PFCLs also affect RPE cell survival, to which they are in contact, for periods ranging from 3 to 7 days.<sup>10</sup> Nevertheless, scotomas and visual acuity improve after removal of retained subretinal PFCLs.<sup>10,11</sup> Although long-term retinal toxicity has been documented, trans-operative use of PFCLs in the subretinal space may be safe due to the short duration of contact.

One may question the microscopic presence of PFCL in the subretinal space after its apparent removal. This issue might be hard to demonstrate since PFCLs usually evaporate during preparation for histological evaluations. A new technique for staining PFCLs has been described in which these compounds are mixed with stained semifluorinated alkanes. Stained PFCLs might prove useful for better visualization at the time of removal and may also be valuable in establishing the subretinal presence of PFCLs on histopathologic sections. Unfortunately, this combination is still not commercially available.<sup>12</sup> Despite this argument, the current technique of subretinal PFCL injection may still prove advantageous considering the consequences of retained fibrous proliferation and multiple retinotomies necessary for its removal.

The use of PFCLs in the subretinal space has been reported for harvesting and relocation of RPE grafts for treating age related macular degeneration.<sup>13</sup> Some of the advantages mentioned by the authors are increased subretinal space provided by PFCLs, adequate flattening of the graft and better hemostasis during surgery. This technique was attempted

in 4 patients and the authors reported adequate PFCL removal, complete retinal reattachment, graft revascularization, and improvement in central fixation and best corrected visual acuity (BCVA). These findings suggest that the transoperative use of subretinal PFCLs could be a feasible alternative.

PFCL-air-silicone exchange was our preferred technique, although direct PFCL-silicone oil exchange is another option. We believe that due to their high surface tension, a water meniscus is created in contact between PFCLs with water and silicone oil that may contribute to retinal slippage during exchange.

PFCL-perfused vitrectomy has also been performed for treatment of diabetic and rhegmatogenous retinal detachments with promising results.<sup>14</sup> Electroretinography (ERG) was not altered and showed a trend toward improvement. In one patient, PFCL entered the subretinal space and was removed under air; this complication did not seem to alter the visual outcome.

En bloc perfluorodissection is a novel technique for treatment of tractional retinal detachment.<sup>15</sup> This procedure is accomplished by injecting PFCL between the retina and the posterior hyaloid in order to separate tissue from the subjacent retina. The technique provides similar advantages as PFCL-perfused vitrectomy using considerably smaller amounts of PFCL.

The technique described herein was employed in five eyes with chronic retinal detachment and subretinal PVR, and we encountered no deleterious effects. Postoperatively, small residual perfluorocarbon bubbles were present in one eye under the midperipheral retina (patient 3) but visual acuity stabilized at 20/400 six weeks postoperatively and remained unchanged. In order to prevent this complication, we believe that subretinal PFCLs should be removed using slow active aspiration under BSS to take advantage of the surface tension of the PFCL bubble.

Although retained PFCLs in the subretinal space seem to be toxic, we consider our technique a viable alternative to extensive manipulations in eyes with subretinal PVR in which the abnormal tissue has to be removed in order to reattach the

retina. We do not recommend this technique in eyes with good visual potential or in cases in which subretinal PVR is localized and can be removed by other techniques.

### Conflicts of Interest

None.

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