



## Original Article

# Anatomical outcome after pars plana vitrectomy using silicone oil versus C<sub>3</sub>F<sub>8</sub> gas tamponade for the management of rhegmatogenous retinal detachment.

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**INTRODUCTION:** Rhegmatogenous retinal detachment (RD) occurs when fluid from vitreous cavity passes through a retinal break into the subretinal space. There are different types of retinal reattachment surgeries among which pars plana vitrectomy (PPV) is a preferential surgical procedure for the management of complex rhegmatogenous retinal detachments (RRD). A tamponading agent (silicone oil or C<sub>3</sub>F<sub>8</sub> gas) is required to decrease the recurrence of retinal detachment.

**OBJECTIVE:** This study was done to compare the anatomical outcome after pars plana vitrectomy using silicone oil versus C<sub>3</sub>F<sub>8</sub> tamponades for the management of rhegmatogenous RD.

**STUDY DESIGN:** This was a prospective, comparative, interventional (quasi-experimental) study.

**PLACE AND DURATION OF STUDY:** Ophthalmology department unit-3 Mayo Hospital Lahore and duration was 6 months from September 2016 to March 2017.

**MATERIAL AND METHODS:** Fifty eyes of fifty patients that underwent PPV with silicone oil versus gas C<sub>3</sub>F<sub>8</sub> tamponades were enrolled in this study. Pars plana vitrectomy was done with 23G vitrectomy system. On the basis of completely flat retina at least 6 to 8 weeks postoperative or oil associated complications silicone oil removal was done. Postoperatively all the patients were followed up on the next day, after 7 days and then at 1 month, 3 months and 6 months interval. According to the surgical procedure performed the patients were divided into two groups. Both groups were compared regarding anatomical outcome. The number of patients in PPV plus Silicone oil and PPV with C<sub>3</sub>F<sub>8</sub> gas group were equal 25 (50%), 25 (50%) respectively.

**RESULTS:** Anatomical attachment of the retina was achieved in 22/25 (88%) patients in PPV with Silicone Oil group after Removal of Silicone Oil (ROSO) and in 23/25 (92%) patients in PPV plus C<sub>3</sub>F<sub>8</sub> group after the absorption of the gas and re-detachment occurred in 3 eyes (12%) in silicone oil and in 2 patients (8%) in the gas groups. Attainment of visual acuity of 6/60 or more which was gained in 44 (88%) of patients after ROSO or absorption of C<sub>3</sub>F<sub>8</sub> gas as the case may be. Anatomical outcome rates were same in both groups primarily and in final situation. Significant differences were not seen between both the groups regarding primary and final anatomical outcome. According to our results anatomically, either of the two options (PPV plus silicone oil or PPV plus C<sub>3</sub>F<sub>8</sub> gas) can be used in the treatment of rhegmatogenous RD. Although more complications were noted in the silicone oil group as compared to gas.

**CONCLUSION:** Silicone oil or C<sub>3</sub>F<sub>8</sub> gas tamponades gave same results regarding reattachment of the retina and to improve or preserve vision. No major differences were noted in the anatomical outcomes between both tamponading agents, the choice of an internal tamponading agents should be individualized for each patient.

**KEYWORDS:** (PPV) pars plana vitrectomy; (RRD) rhegmatogenous retinal detachment; (ROSO) removal of silicone oil, (PVR) Proliferative vitreoretinopathy,



## INTRODUCTION:

Rhegmatogenous RD is characterized by the presence of a retinal break associated with vitreoretinal traction that allows liquefied vitreous accumulation under the neurosensory retina, separating it from the RPE. RD will not occur even though a retinal break is present, if the vitreous is not at least partially liquefied and traction is absent. More than 40% of RDs occur in myopic eyes; higher the refractive error the greater the risk of RD.

Vitreous degeneration and PVD and predisposing lesions such as lattice and snailtrack degeneration are more common in myopia. Highly myopic eyes are also at risk of developing RD due to small round holes in chorioretinal atrophy and from macular holes. Vitreous loss during cataract surgery and laser capsulotomy also carry a higher risk of RD in highly myopic eyes. It affects about 1 in 10 000 of the population each year, with both eyes eventually involved in about 10%.<sup>1</sup>

Retinal reattachment surgical procedure becomes successful when there is no remaining traction between vitreous and retina and all the breaks in the retina are properly sealed. Gonin first described the repair of RD in 1920 and advancement in the technology have given better surgical results.<sup>2,3</sup> In 1970 Robert Machemer launched the 3 ports PPV to modernize the VR surgery.<sup>4</sup> The use of latest vitrectomy machines and long acting tamponading agents, such as silicone oil or C<sub>3</sub>F<sub>8</sub> gas to treat complicated retinal detachments, have resulted in better outcome of RD surgery. Pars plana vitrectomy (PPV) has become the first choice of many VR surgeon especially in patients with RRD because small retinal tears can be directly visualized, sub-retinal fluid can be internally drained, endolaser applied, and PVR is less likely to develop.<sup>5,6</sup>

The objective of this study was to evaluate the anatomical outcome after PPV with various tamponading agents that is silicone oil (SO) or gas (C<sub>3</sub>F<sub>8</sub>) in patients with RRD repair postoperatively at the department of Ophthalmology Mayo Hospital Lahore during October 2016 to March 2017.

## MATERIALS AND METHODS:

Fifty eyes of fifty patients, who went through PPV surgery for RRD during October 2016 to March 2017 were included in this study. Patients clinical details were reviewed retrospectively. The approval was taken from the Ethical review board of KEMU. Informed written consent was taken from the patients. History and clinical examination was done preoperatively and clinical findings were collected that is best-corrected visual acuity, intraocular pressure (IOP) with applanation tonometer, anterior segment examined with slit-lamp. Posterior segment examination was done with 78 or 90 diopter lenses and indirect ophthalmoscope with dilated fundus. Retinal diagrams were drawn to see the extent of RD, with or without macular involvement, and find out the location and numbers of retinal breaks.

Uncomplicated RRD patients over the age of 15 years were included in this study. Patients with giant retinal tears, PVR more than grade C, patients with history of recurrent RD surgery, ocular trauma, retinal dystrophies, vitreous opacities or vitreous hemorrhage, macular diseases like geographic atrophy, CNVM (choroidal neovascular membrane), macular scar were excluded.

Patients were consecutively selected. All the surgeries were performed by same surgeon. Patients were equally divided in both groups 25 patients in PPV plus Silicone oil group and 25 patients in PPV plus C<sub>3</sub>F<sub>8</sub> group.

Patients were evaluated for the anatomical reattachment of the retina, functional achievement and complications on day one, 7<sup>th</sup> day and then one-month interval till the 6<sup>th</sup> month. During the follow-up visit retinal attachment was determined by best corrected visual acuity and dilated fundus examination and at the end of the follow-up visits if retinal attachment was observed then it was considered anatomical success.

Surgery was performed under local or general anaesthesia (where necessary) in all eyes. A 23-gauge vitrectomy system was used in both PPV groups. Incisions were made 3.5 mm from the limbus. Vitrectomy was done and with the help of scleral indentation search for retinal breaks was done in the peripheral and central retina. Drainage of subretinal fluid was done through the same break or through the new retinotomy. Heavy liquid (Perfluorocarbon) was used to flatten the retina. Endolaser photocoagulation was done around the retinal breaks and in the periphery under air. As a vitreous tamponade C<sub>3</sub>F<sub>8</sub> gas 14% concentration in PPV + C<sub>3</sub>F<sub>8</sub> group (n = 25) and Silicone Oil 5000cSt in PPV+Silicone Oil group (n = 25) were used. Silicone oil remained in the eyes for at least 2 months in PPV plus Silicone oil group. Subconjunctival antibiotic, steroids combination was injected. At the end of the study all the data was collected and statistically evaluated. SPSS (Statistical Package for Social Sciences) was used to evaluate the data and chi square test was used to analyze the statistical results. The p < 0.05 was considered as statistical significance level.

## RESULTS:

50 patients that underwent RRD surgery were evaluated. Right eye (RE) was involved in 28 (56%) and left (LE) eye was involved in 22 (44%) patients. In 50 cases, 25 (50%) were PPV with SO, and 25 (50%) underwent PPV with C<sub>3</sub>F<sub>8</sub> gas. The mean age of the patients was 43.91 ± 15.82 years (range 18-72) years. Male to female ratio of the patients was 2.84, 37 (74%) were males and 13 (26%) were females. Mean intraocular pressure IOP was 13.6+3.72mmHg and it ranged from 9mmHg to 29mmHg postoperatively. In 50 patients that were operated for retinal detachment, 28 patients had crystalline lens, 18 were pseudophakic and 4 were aphakic. According to PVR grading 3 patients had grade A, 24 patients

had grade B and 23 patients had grade C PVR. Patients' parameters before operation are presented in Table 1.

**Table 1:** Preoperative General Characteristics.

Variables	Frequency	%
Eyes involved	50	100
Right Eye	28	56
Left Eye	22	44
<b>Gender</b>		
Male	37	74
Female	13	26
<b>Age of patients in years</b>		
Mean $\pm$ SD	43.9 $\pm$ 15.82	
Range	18 - 72	
<b>Pre-Operative Visual Acuity</b>		
3/60 to 6/60)	11	22
1/60 to 2/60)	17	34
CF	9	18
HM	13	26
<b>Procedure performed for surgery</b>		
PPV plus silicone oil	25	50
PPV plus Gas	25	50
<b>IOP (mmHg)</b>		
Mean $\pm$ SD	13.6 $\pm$ 3.72	
Range	9 - 29	
<b>Lens Status</b>		
Natural crystalline lens	28	46.6
Pseudophakia	18	43.7
Aphakia	4	9.7
<b>Location of breaks</b>		
Superior	36	72
Inferior	11	22
sup/inf.	3	6
<b>PVR Grades</b>		
Grade A PVR	3	6.8
Grade B PVR	24	51.5
Grade C PVR	23	41.7

According to the detached quadrants of the retina, 6.9% of cases had one quadrant involvement (60.4%) patients had 2 quadrants involvement, 15.8% had 3 quadrants involved,

16.8% had total involvement. The mean numbers of quadrants involved were  $2.42 \pm 0.84$ . 83.3% of cases had macular involvement. Regarding macular involvement statistically no significant difference was present among groups ( $p = 0.426$ ). Between the locations and numbers of breaks, highest rate was single break (72%) then 2 breaks (14%), and more than 2 (12%). Superotemporal quadrant break involvement was 72%, inferior quadrant involvement was 22%, and both, superior and inferior quadrants involvement was 6%. In terms of the detached quadrants, macular involvement, numbers and locations of breaks no major differences were observed between the study groups ( $p > 0.05$ ) as shown in Table 2.

**TABLE 2:** Retinal involvement parameters

Parameters of retinal involvement	Number	p-value
<b>Detached quadrants numbers (mean<math>\pm</math>SD)</b>	2.43 $\pm$ 0.85	
PPV+SO	2.38 $\pm$ 0.85	0.235**
PPV+ C <sub>3</sub> F <sub>8</sub> Gas	2.62 $\pm$ 0.91	
<b>Macula detached/attached</b>	41/9	
PPV+SO	20/5	0.428*
PPV+ C <sub>3</sub> F <sub>8</sub> Gas	22/3	
<b>Breaks Numbers (1/2/?3)</b>	36/7/7	
PPV+SO	15/6/4	0.081*
PPV+ C <sub>3</sub> F <sub>8</sub> Gas	18/4/3	
<b>Location of breaks (sup/inf/sup+inf)</b>	36/11/3	
PPV+SO	18/5/2	0.380*
PPV+ C <sub>3</sub> F <sub>8</sub> Gas	20/4/1	

Anatomical attachment of the retina was achieved in 22/25 (88%) patients in PPV with Silicone Oil group and in 23/25 (92%) patients in PPV plus C<sub>3</sub>F<sub>8</sub> group after the absorption of the gas. Failure occurred anatomically in 3 eyes (12%) in silicone oil cases and in 2 patients (8%) in the gas category. 6/60 or better visual acuity which was achieved in 44 (88%) of patients postoperatively after ROSO or absorption of C<sub>3</sub>F<sub>8</sub> gas as the case may be. Silicone oil remained in the eyes for 8 weeks. Anatomical outcome rates were same in both groups primarily and till the end of the study. According to our anatomical results either of the two options (PPV plus SO or PPV plus C<sub>3</sub>F<sub>8</sub> gas) can be used in the treatment of rhegmatogenous RD. Although more complications were noted in the silicone oil group as compared to gas. New or missed retinal breaks and inadequate gas or silicone oil tamponades especially in the inferior retina were noticed as the main reason of failure of RD surgery. (Table 3).

**Table 3:** Anatomical success Variables (Attached / Detached Retina)

Variables	Patients No.	Anatomical Outcome		P-value
		Attached Retina	Detached Retina	
<b>Eyes Involved</b>	50	45 (90%)	5 (10%)	
Right	28	27 (96.42%)	1 (3.58%)	0.001
Left	22	18 (81.82%)	4 (18.18%)	
<b>Gender</b>				
Male	37	33 (89.18%)	4 (10.82%)	0.265
Female	13	12 (92.3%)	1 (7.7%)	
<b>Age in years</b>				
Up to 40 years	23	21 (91.3%)	2 (8.7%)	0.715
More than 40 years	27	24 (88.88%)	3 (11.12%)	
<b>Lens Status</b>				
Natural Crystalline lens	28	25 (89.28%)	3 (10.72%)	
Pseudophakia	18	16 (88.88%)	2 (11.12%)	0.358
Aphakic	4	4 (100.0%)	-	
<b>Surgical Procedure performed</b>				
PPV + Silicone oil	25	22 (88%)	3 (12%)	0.524
PPV + Gas (C <sub>3</sub> F <sub>8</sub> )	25	23 (92.0%)	2 (8%)	
<b>IOP (mmHg)</b>				
< 13 mm Hg	23	22 (95.65%)	1 (4.35%)	0.007
13 & above mmHg	27	23 (85.18%)	4 (14.82%)	
<b>Grades of PVR</b>				
Grade A	3	3 (100.0%)	-	0.355
Grade B	24	23 (95.83%)	1 (4.17%)	
Grade C	23	19 (82.6%)	4 (17.4%)	
<b>Location of break</b>				
Superior	36	34 (94.45%)	2 (5.55%)	0.003
Inferior	11	9 (81.82%)	2 (18.18%)	
Sup. /Inf.	3	2 (66.6%)	1 (33.4%)	

**DISCUSSION:**

Different methods for retinal surgery have been adopted for the management of RRD. Benson et al. in 1997 performed a study to evaluate the most useful surgical technique in RRD and find out that 62% of VR surgeons preferred Silicone Band (SB) surgery, 30% Pneumatic Retinopexy, and 7% preferred PPV.<sup>7,8</sup> Popularity of PPV in RRD surgery has been increased

over time due to new advancements in vitrectomy machines and because retinal tears in the periphery can be localized easily and the chances of PVR has decreased. According to the Preferences and Trends (PAT) survey (2013) conducted by the American Society of Retina Specialists the numbers of retina specialists that prefer to treat RRD with PPV without scleral buckle has increased between 2005 to 2015. From 2005 to 2013 patients treated with PPV without scleral buckle has almost doubled from 30% to 60% and those using scleral buckle has decreased from 25 to 10%. Percentage of those using pneumatic retinopexy has remained stable at 25%.<sup>9</sup> In latest years pneumatic retinopexy has become a less popular technique for treating RRD.<sup>10,11,12</sup>

Silicone oil is made up of repeating units of siloxane. It is described as unexpansile liquid polymer and it forms a clear-cut meniscus throughout. Silicone oil is more viscous than C<sub>3</sub>F<sub>8</sub> gas; however, its buoyancy and surface tension are lower than the gas.<sup>6</sup> More complications are associated with silicone oil as compared to gas. It can emulsify and that is why it needs removal. In this study according to PVR grades, rate of retinal re-detachment after silicone oil removal or after absorption of the gas varied. In patients having preoperative PVR grade A, in all the cases postoperatively retina remained attached till the last follow up visit. However, out of 24 cases that had preoperative RRD with PVR B, retina remained attached in 23 (95.83%) of cases after ROSO or after gas absorption and detached in 1 (4.17%) of patients. We noticed that retinal attachment rate decreased in PVR grade C and out of 23 patients 19 (82.6%) of the cases their retina successfully attached till the end of the study and in 4 (17.4%) of patients, retina remained detached in spite of repeated surgeries. Anatomical triumph was attained in 96% of cases with PVR grade B or lesser according to Demir M et al study.<sup>18</sup> An initial success rate of 88% with PPV and final anatomical success of 96% that was achieved in 225 patients with RRD as reported by Campo et al.<sup>14</sup>

Peripheral retinal tears can be more clearly visualized by scleral indentation and internal illumination in PPV cases. Thus, with clear visualization of peripheral retinal breaks and proper management it gives good anatomical success in patients with RRD. Retinal breaks were detected in 80% of patients with RRD according to Ho et al. Retinal breaks location is reported in 93-100% patients with PPV.<sup>13</sup> In this study retinal breaks location was detected in 49/50 cases (98%) with PPV surgery.

In our study, retinal reattachment was achieved in 45 of 50 patients (90%) in 3 ports PPV groups, and 5 patients needed 2nd surgery. After a single operation anatomical achievement varies between 85% to 95% in RRD cases, however this rate approaches to 97-100% after repeated operations.<sup>15</sup>

Meta-analysis was done from 1966 to 2004 to compare scleral buckling versus PPV that revealed that PPV had better

anatomical outcome in RRD patients.<sup>16,17</sup> Moreover no major difference was seen in patients with pars plana vitrectomy and combined procedure PPV plus scleral buckling regarding anatomical outcome. Retinal reattachment rate of 77% in patients treated with PVR with silicone oil and 79% in patients treated with PVR with C<sub>3</sub>F<sub>8</sub> tamponade in another study.<sup>18</sup> In the silicone oil study, SO and C<sub>3</sub>F<sub>8</sub> gas gave similar results in patients with retinal detachment associated with PVR.<sup>19,20</sup> This study noticed statistically no significant differences between SO and C<sub>3</sub>F<sub>8</sub> gas tamponades use in the PPV groups regarding success rates. Silicone oil and gas tamponades use in pseudophakic RRD patients few studies focused on their efficacy. In the present study, we compared the efficacy of PPV plus Silicone Oil and PPV with C<sub>3</sub>F<sub>8</sub> tamponades in pseudophakic RRD patients and no major differences were noted between both groups regarding anatomical results. In the phakic and pseudophakic RRDs no significant differences were noted between the surgical procedures performed.

#### CONCLUSION:

Silicone oil or C<sub>3</sub>F<sub>8</sub> gas can be safely used in patients with RRD because both tamponading agents offer similar benefits in terms of retinal reattachment. This is particularly important as SO, although used more commonly, has more complications as compared to C<sub>3</sub>F<sub>8</sub> gas.

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