

Combined removal of silicone oil plus internal search (ROSO-plus) following retinal detachment surgery

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CLINICAL STUDY

Abstract

Purpose To report the rate of retinal redetachment and intervention with combined removal of silicone oil plus internal search (ROSO-plus) and to report the pathology identified.

Methods Preoperative and peroperative findings were related to postoperative failure of the surgery defined as retinal redetachment postoperatively or silicone oil *in situ* at the final follow-up.

Results Sixty-three patients were included in the study. Mean follow-up was 13 months. Retinopexy and further tamponade were used in 22 patients. Overall 'ROSO-plus' failed in 13 (21%) patients. Patients with subretinal fluid (SRF) in the inferior quadrants of the fundus during 'ROSO-plus' were particularly at risk of failure at 86% (six of seven patients) *vs* 12.5% (7/56) for the remainder ($P = 0.0002$, relative risk = 6.9, 95% confidence interval 3.2–14.6). The overall success rate at final follow-up (after any further surgery) for a flat retina without oil *in situ* was 83%.

Conclusion The 'ROSO-plus' procedure allowed identification of problems expected to result in anatomical failure. Treatment did not prevent a high rate of postoperative retinal detachment. Refinement of the treatment algorithm is required with perhaps more use of silicone oil reinsertion in high-risk eyes.

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Introduction

Silicone oil (polydimethyl siloxane) is widely used as an intraocular tamponade agent in

surgery for complicated retinal detachments such as those associated with proliferative vitreoretinopathy (PVR), or giant retinal tear (GRT). Planned removal of the oil at a later operation is preferred where possible¹ to reduce the incidence of complications such as cataract, glaucoma, and keratopathy. However, redetachment after oil removal is a leading cause of vision loss in these patients and may occur in 9–29%.^{2–6} Often the operation is performed without intraoperative retinal examination with detection of the retinal redetachment at the postoperative visits when PVR may have already developed obscuring the initial reason for the redetachment. Therefore, it is appropriate to re-examine the retina immediately after the removal of the oil while the patient is undergoing surgery thereby allowing identification of any potential causes for redetachment and allow early intervention. This has been performed using the binocular indirect ophthalmoscope.¹ This modality has the potential for missing subtle retinal changes and is unlikely to be used during any intervention. Modern noncontact wide-angle visualisation methods such as the BIOM II (Oculus, USA) allow a high-resolution view of the retina and could be used for examination with a high chance of detecting any abnormalities. Any surgical intervention could be performed immediately by pars plana vitrectomy (PPV) approach. In addition, any other pathologies could be dealt with such as retained oil emulsion or epiretinal membrane (ERM), which occurs in 10–38%^{7,8} of eyes treated for PVR with silicone oil.

We have routinely combined removal of silicone oil plus internal search (ROSO-plus) by deep indentation⁹ using a standard 3 port set up for PPV and wide-angle viewing system. We expected this method to prove advantageous by

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reducing redetachment rates in the postoperative period by allowing treatment of immediate retinal detachment, retinal tears, or unsealed retinectomy edges. We report our findings and results with this technique.

Materials and methods

In general, in the Vitreoretinal service at St Thomas' Hospital, we aim to remove silicone oil from all patients if possible. Patients are evaluated in clinic with both slit-lamp indirect biomicroscopy and binocular indirect ophthalmoscopy. Oil removal is planned once the retina has been fully attached, provided intraocular pressure is not < 10 mmHg. The examination is repeated when the patient attends for surgery. If retinal detachment persists under oil we reoperate until reattachment is achieved or until further surgery is deemed not to be in the patient's best interest. Subretinal fluid (SRF) found at 'ROSO-plus' is therefore likely to have collected during oil removal. We do not use prophylactic 360° laser or encircling buckles in patients with silicone oil insertion.

Data from 63 consecutive patients undergoing the 'ROSO-plus' procedure between June 2001 and March 2004 were entered onto a surgical electronic patient record (Retinasurgery freeware in Microsoft Access). Indications for original surgery, findings at oil removal and additional procedures performed were recorded. Follow-up data on final retinal status and need for further surgery were noted. Where entries were incomplete, hospital case records were studied. Failure of the surgery was defined as retinal redetachment or silicone oil *in situ* at the final follow-up.

The 'ROSO-plus' procedure

Oil removal was performed using a standard 20-gauge three port pars plana method. One superior sclerotomy was enlarged to 2 mm in length to evacuate the oil either by passive egress or using aspiration with a short canula. The enlarged sclerotomy was partially closed to re-establish a closed system with a 7/0 suture. We then performed internal search with endoillumination and deep indentation, using a wide-angle noncontact viewing system (BIOM II, Oculus, USA). Particular attention was paid to retinectomy edges and the ends of GRTs. ERM was peeled and emulsified oil removed as necessary. Retinopexy and internal tamponade were used for untreated breaks or retinal detachment. Fisher's exact test was used to determine the difference between proportions.

Results

Sixty-three eyes of 63 consecutive patients treated for retinal detachment with silicone oil who had the

'ROSO-plus' procedure were studied. Mean age at oil removal was 54 years (8–87 years). The group comprised 39 males and 24 females. Mean duration of silicone oil tamponade before 'ROSO-plus' was 12 months (range 3–54 months; median 8.75 months). Mean duration of follow-up was 13 months (range 3–36 months) after the 'ROSO-plus' procedure.

Silicone oil originally had been inserted for failed rhegmatogenous retinal detachment (RRD) surgery in 16 patients. In this circumstance we used oil when PVR was present or deemed to be at high risk of occurring. The other 47 had oil inserted at primary surgery for retinal detachment. This group comprised 13 patients presenting with RRD and PVR, 10 following trauma, seven with GRT, four with RRD from multiple retinal breaks, four with viral retinitis, and two with myopic macular hole detachment. There were single cases of choroidal haemorrhage during vitrectomy for uncomplicated RRD, RRD and a very large retinal break, uveal effusion syndrome, tractional retinal detachment secondary to retinal vein occlusion, RRD complicating toxoplasma chorioretinitis, detachment following macular hole surgery, and detachment following retinal biopsy for posterior uveitis.

Nineteen patients had relieving retinotomy with anterior retinectomy. Five of these were performed at the time of initial silicone oil insertion, 14 were performed at a secondary procedure with oil reinsertion. Mean number of retinal operations before oil removal was 1.8 (1–6).

In the postoperative period the failure rate after 'ROSO-plus' was 21% (13 of 63 eyes) including one patient with a flat retina but with oil *in situ* at the final follow-up. A group of patients in whom retinal detachment was found at 'ROSO-plus' with SRF in the inferior quadrants of the fundus were particularly at risk of failure at 86% (six of seven patients, including a patient with a flat retina and silicone oil *in situ* at final follow-up). The failure rate for the rest of the patients was 12.5% (7/56). These two rates were significantly different at $P=0.0002$, with a relative risk for failure, if inferior SRF is found, of 6.9 (95% confidence interval 3.2–14.6).

Those patients with only superior or posterior SRF had a risk of failure of 16% (1/6), significantly less than the inferior SRF group at $P=0.03$. Table 1 shows the clinical features of the 13 patients in whom SRF was found at the time of 'ROSO-plus'.

Other patterns of abnormality were detected but were not found to induce a significantly higher risk. Untreated retinal breaks without SRF were found in five patients, only one redetached postoperatively (20%). Two of these were large round holes in patients with retinitis; one was a posterior break from PVR peeling and one patient with

Table 1 Patients with subretinal fluid at 'ROSO-plus' surgery

Patient number	Diagnosis	Preoperative retinectomy	Retinal break	SRF location	Surgical intervention	Postoperative outcome
1	Primary PVR	No	No	Inferior	Nil	Detached
2	Failed RRD	No	Yes	Inferior	Oil and retinectomy	Detached with silicone oil
3	Failed RRD	No	Yes	Inferior	SF6	Detached
4	Primary PVR	No	Yes	Inferior	Oil and retinectomy	Detached with silicone oil
5	ARN	No	Yes	Inferior	Oil	Attached with silicone oil
6	Failed RRD	No	No	Posterior	Nil	Attached
7	Failed RRD	Yes	Yes	Superior	SF6	Detached
8	Failed RRD	Yes	Yes	Superior	SF6	Attached
9	Primary PVR	Yes	Yes	Total	C3F8	Attached
10	Failed RRD	Yes	Yes	Inferior and superior	C3F8	Detached
11	Failed RRD	No	No	Superior	SF6	Attached
12	Failed RRD	No	No	Superior	SF6	Attached
13	Primary PVR	No	Yes	Superior	SF6	Attached

RRD = rhegmatogenous retinal detachment; PVR = proliferative vitreoretinopathy; Oil = silicone oil; SF6 = sulphur hexafluoride gas; C3F8 = perfluoropropane gas; ARN = acute retinal necrosis; SRF = subretinal fluid.
The clinical characteristics, findings at 'ROSO-plus' and surgical intervention at 'ROSO-plus' procedure are shown for all the patients in whom retinal detachment was found immediately at the time of silicone oil removal. The findings postoperative to the 'ROSO-plus' procedure are described.

Table 2 Rates of failure after 'ROSO-plus' in relation to the indication for initial silicone oil insertion

Failed RRD surgery	Primary PVR	Trauma	ARN/CMV	GRT	Multiple retinal breaks	Other	Total
5/16 31%	4/12 33%	2/10 20%	1/4 25%	1/7 14%	0/4 0%	0/9 0%	13/62 21%

RRD = rhegmatogenous retinal detachment; PVR = proliferative vitreoretinopathy; ARN = acute retinal necrosis; CMV = cytomegalovirus retinitis; GRT = giant retinal tear.

a superior round hole with no evidence of PVR. The first three were treated successfully with laser and air tamponade and the last with retinopexy alone. A patient with a superior break and flat retina overlying subretinal bands was treated with sulphur hexafluoride but redetached postoperatively.

Retinopexy was topped up where deemed inadequate in seven further cases with no additional break or SRF found (air tamponade was used in six patients and sulphur hexafluoride in one). Only one patient redetached (14%).

In addition a number of other procedures were performed. Perfluorohexyloctane was used to remove emulsified oil in seven eyes, macular ERMs were peeled in seven patients (three of these also had tamponade for other pathology; one patient with ERM peel alone detached postoperatively), peripheral PVR membranes were removed in two and fluid-air-fluid exchange alone was used in one to aid the evacuation of emulsified oil.

In the remaining 29 patients in whom no intervention was performed or pathology found three patients failed after 'ROSO-plus' (10%).

Preoperative features were also assessed and are shown in Table 2. The risk of failure in patients with failed RRD surgery or primary PVR (essentially a group of patients with PVR or at high risk of PVR) was increased, but did not reach statistical significance $P = 0.07$, relative risk 2.6 (95% confidence intervals of 0.9–7.7).

The final acuity results are summarised in Figure 1. At final follow-up, three patients had no perception of light. The retina remained detached in nine patients at final follow-up, attached under oil in two, and attached with no oil in 52 (83%).

Discussion

In this study, a new approach to the management of patients with silicone oil *in situ* has been described. We

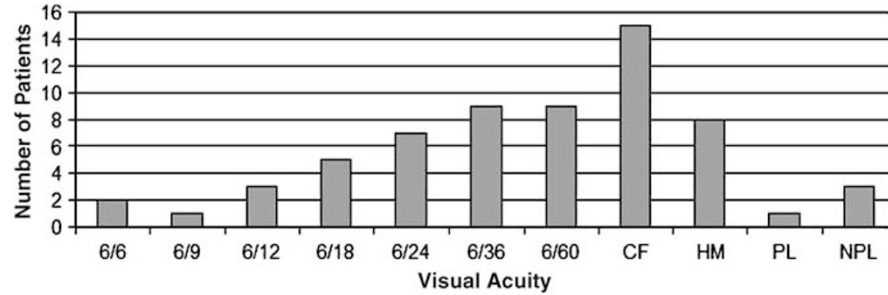


Figure 1 Visual acuity at final follow-up of all patients following 'ROSO-plus'.

have used the 'ROSO-plus' procedure with deep indentation at the time of oil removal using a wide-angle noncontact viewing system to allow close inspection of retinectomy edges, treated tears, and the macula. This approach was suggested by Kampik and Gandorfer¹⁰ but no results have been previously reported. We chose to perform 'ROSO-plus' because preoperative assessment of the retina can be inadequate in silicone oil-filled eyes. Often preoperative indentation is restricted in a firm unanaesthetized eye and visualisation of the extreme periphery is hindered by interface reflections of the silicone oil. In addition, after removal of tamponade retinal elevation or breaks may be revealed. The operating microscope allows a more detailed view than that achieved with the binocular indirect ophthalmoscope during surgery. The procedure is now more easily achieved without the need for enlarging the sclerotomy with the widespread availability of machine-driven oil-extrusion syringes.

During 'ROSO-plus' we expected to find features in the retina that were not detected preoperatively. Indeed, we detected a number of abnormalities, which would be regarded as increasing the risk of postoperative failure such as immediate retinal redetachment in 13 patients (nine with breaks or open retinectomy edges) and untreated retinal breaks without SRF in a further five patients.

The major finding of the study was the identification of a group of patients at particular risk of postoperative failure of surgery. Those patients with any SRF present in the inferior periphery at the time of 'ROSO-plus' were at a much higher risk of failure, relative risk 6.9, compared with the rest of the patients. Of these patients, 83% failed by our criteria compared with 12.5% of the other patients. Although other features were found such as superior or posterior retinal detachment, flat breaks or untreated retinectomy edges, these were easy to deal with by retinopexy and tamponade. Unfortunately if inferior SRF was present, these interventions did not prevent failure and another approach must be found. Patients failed in this group with both gas and silicone oil tamponade.

Since the inferior retina is poorly tamponaded by these agents and is also likely to have more PVR it may be necessary to employ heavy silicone oil agents in these patients. This will require testing in further studies. Our intervention rate for prevention or treatment of redetachment was 39%. This is somewhat higher than the expected redetachment rate without intervention, suggesting that not all findings would have caused detachment.

We took the opportunity to remove emulsified oil and ERM during 'ROSO-plus' apparently without increasing the chance of failure. Additional procedures at the time of oil removal have been described before in selected cases including ERM peeling^{7,11,12} and additional retinopexy, and tamponade.

Other investigators have suggested that preoperative risk factors may indicate a higher risk of failure after silicone oil removal, for example, anterior PVR¹³ and multiple procedures with oil *in situ* before removal.¹⁴ However, perhaps due to the small number of patients, preoperative risk factors did not reach a significant level of predictability. In this study, this would have made it difficult to predict the patients in whom preoperative interventions such as 360° laser treatment would have been appropriate.

Potential drawbacks of 'ROSO-plus' include increasing retinal light exposure, increasing surgical time, unnecessary intervention, and possible stimulation of PVR. However, we feel that the creation of one extra sclerotomy and the performance of deep indentation with endoillumination are unlikely to increase the risk of surgery excessively in comparison to the risk of a routine oil out procedure. The potential risks of not performing a search at the time of surgery are prolonged period of retinal detachment and secondary PVR before problems are noticed at the postoperative visits. Our final success rate of 83% was similar to other studies although a direct comparison is difficult because of case mix and the degree to which oil removal is pursued by the surgical team. Our patients were high-risk patients for retinal redetachment. Others using silicone oil, for

example in macular hole surgery should expect better results.¹⁵

In conclusion, the 'ROSO-plus' procedure allowed the identification of an at-risk group of patients for failure of surgery for silicone oil removal. Modification of the surgical strategy to maintain retinal reattachment postoperatively can now be performed to increase success rates.

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