

Removal of silicone oil following diabetic vitrectomy

R V Pearson, D McLeod,* Z J Gregor

Abstract

The outcome of the removal of silicone oil from previously vitrectomised diabetic eyes was studied in a series of 25 eyes in 24 patients. Originally the patients presented with complex retinal detachments associated with proliferative diabetic retinopathy and all had reattached retinas after the initial operation. During the silicone tamponade, a number of complications had occurred. Cataract had developed in 14 eyes, glaucoma in eight, and re-proliferation of fibrous membranes in 12. After the removal of silicone the retina re-detached in three eyes (in all cases associated with severe postoperative haemorrhage), hypotony occurred in five eyes (transiently in four) and the seven eyes remaining phakic developed a cataract. In spite of these problems the eventual visual acuities returned to the immediate post-vitrectomy levels in almost all the eyes.

(*Br J Ophthalmol* 1993; 77: 204-207)

The results of vitreous surgery for severe complications of proliferative diabetic retinopathy (PDR) have improved dramatically in recent years.^{1,2} If a retinal break is present at surgery short term intraocular gas tamponade may be effective in securing retinal re-attachment provided the break is sealed and vitreoretinal traction is adequately relieved. Occasionally, however, a prolonged tamponade using silicone oil may be preferred if the surgeon suspects that gas tamponade may not lead to lasting retinal re-attachment. In eyes with chronically detached or excessively oedematous retinas, for example, it may be difficult to achieve effective endolaser photocoagulation of breaks or of ischaemic retina. In such cases silicone oil tamponade is useful as it limits any postoperative haemorrhage and allows immediate postoperative photocoagulation.^{3,4}

Anterior segment complications of intraocular silicone such as cataract, glaucoma, and keratopathy⁵⁻⁹ have been widely reported in non-diabetic and diabetic eyes. In addition, silicone oil in the diabetic eye may be associated with re-proliferation of fibrocellular or even fibrovascular epiretinal membranes sometimes with traction retinal re-detachment.^{3,10}

It has been suggested that early removal of silicone oil may prevent some of these problems.¹¹⁻¹³

The most serious complication of the removal of silicone is retinal re-detachment, which in non-diabetic eyes may occur in up to 33% of cases.¹⁴⁻¹⁶ In diabetic eyes such a complication can be particularly serious as it is frequently associated with intractable rubeosis iridis.¹⁷

It has been our clinical impression that retinal re-detachment following the removal of silicone oil is less common in diabetic eyes than in their

non-diabetic counterparts. The aim of this study was to document the consequences of silicone oil removal in a series of patients who had undergone vitrectomy for complications of diabetic retinopathy.

Patients and methods

A selected series of 25 eyes in 24 patients underwent removal of silicone oil following previous vitrectomy, epiretinal membrane dissection, and fluid/silicone oil exchange for advanced PDR complicated by retinal detachment (Table 1). Thirteen patients were male and the average age was 34.2 years (range 18-59 years). Twenty two patients had insulin dependent diabetes mellitus with an average duration of 19.4 years (range 11-33 years). Two patients were non-insulin dependent with a known duration of 1 to 14 years. Sixteen of the 25 eyes had received scatter laser photocoagulation before vitrectomy and no photocoagulation had been used in nine. All eyes were phakic and five had early lens opacities.

Vitrectomy, membrane delamination, and/or segmentation and silicone oil injection (1000 cS) was combined with endophotocoagulation in 20 eyes, cryotherapy to the post-sclerotomy retina and/or more widespread areas of peripheral retina in nine eyes, removal of subretinal membranes in two eyes, and scleral buckling in three eyes. Eyes which were not treated with extensive scatter laser photocoagulation intra-operatively received panretinal photocoagulation during the immediate postoperative period.

Complete retinal re-attachment had been achieved immediately after the initial operation in all eyes. All patients were under the care of two vitreoretinal surgeons (D McL, ZJG).

The usual indication for removal of silicone oil

Table 1 Vitreoretinal characteristics in 25 eyes before initial surgery

	Eyes
Traction retinal detachment	11
Combined traction/rhegmatogenous retinal detachment	14
Macula detached	23
Vitreous haemorrhage	20

Table 2 Complications before silicone oil removal

	Eyes
<i>Anterior segment</i>	
Cataract	14
Raised intraocular pressure	5
With lens swelling	3
With rubeosis	1
With hyphaema	1
Silicone oil in anterior chamber	2
Emulsification of silicone oil	1
<i>Posterior segment</i>	
Epiretinal re-proliferation	12
With traction detachment	3
Without traction detachment	9

Moorfields Eye Hospital,
City Road, London
EC1V 2PD
R V Pearson
D McLeod
Z J Gregor

*Current address:
Manchester Royal Eye
Hospital, Department of
Ophthalmology, Oxford
Road, Manchester
M13 9WH.

Correspondence to:
Mr Zdenek J Gregor, FRCS,
Moorfields Eye Hospital, City
Road, London EC1V 2PD.

Accepted for publication
12 January 1993

Table 3 Indications for silicone oil removal in 25 eyes

	Eyes
Prevention of complications	4
Cataract	14
Increased intraocular pressure	
With lens swelling	3
Neovascular	1
With hyphaema	1
Non-resolving retrolenticular and preretinal haemorrhage	2
Silicone emulsification and epiretinal proliferation	1

Table 4 Additional procedures at silicone oil removal

Extracapsular cataract extraction and lens implant	11
Extracapsular cataract extraction without implant	4
Pars plana lensectomy	1
Intracapsular cataract extraction	1
Lensectomy/membrane dissection/scleral buckle	1
Primary posterior capsulotomy	3
Epiretinal membrane dissection	1
Trabeculectomy	1
Peripheral iridectomy	11
Intravitreal air injection	4

Table 5 Postoperative complications of silicone oil removal

Postoperative inflammation	7
Severe intraocular haemorrhage	4
Peripheral choroidal detachment	1
Hypotony (less than 10 mm Hg)	5
Iris prolapse	1
Posterior capsular thickening	6
Cataract (in seven phakic eyes)	7
Retinal detachment	3

NB Ten eyes had multiple complications, the remaining 15 were complication free.

was either established anterior segment complications (such as cataract or glaucoma) or in an attempt to prevent such complications. In five eyes the intraocular pressure rose to a mean untreated level of 35.8 mm Hg (range 28–50 mm Hg). This was associated with the shallowing of the anterior chamber owing to lens swelling in three eyes, with postoperative hyphaema in one eye, and another eye developed rubeosis iridis. In two cases, the silicone oil was removed because of severe postoperative retrosilicone haemorrhage (Tables 2 and 3).

Silicone oil was removed using the technique described by Leaver *et al.*¹⁸ In 20 eyes this was combined with other procedures such as extracapsular cataract extraction (with or without lens implantation), lensectomy, or trabeculectomy (Table 4). Epiretinal membrane dissection with or without scleral buckling was performed at the time of the silicone oil removal in two of the eyes where epiretinal membranes had re-proliferated and a localised retinal detachment had occurred (Table 4). Mean follow up after oil removal was 50 months (6–94 months).

Results

Silicone oil was removed after having been in situ for a mean of 13.5 months (range 1–52 months). Early removal (within 3 months) was performed in order to prevent potential complications in four eyes, to treat increased intraocular pressure owing to lens swelling in four eyes, and to evacuate the retrolenticular and preretinal haemorrhage in two eyes (Table 3). A degree of diffuse haemorrhage was present in most eyes immediately following silicone removal but this cleared within 2–6 weeks. The removal of silicone oil was otherwise uneventful in 15 eyes, but was

associated with complications in 10 eyes (Table 5). Four eyes had dense non-clearing haemorrhage, one of which was associated with hyphaema and high intraocular pressure requiring subsequent vitreous washout and trabeculectomy. In the remaining three eyes, the severe haemorrhage was associated with retinal re-detachment (see below).

Marked postoperative intraocular inflammation occurred in seven eyes and this was controlled by intensive topical steroids. Hypotony (intraocular pressure less than 10 mm Hg) occurred in five eyes. This was transient (less than 10 days) in four eyes, but in one eye the intraocular pressure remained at 6 mm Hg at 11 months. Of the five eyes with preoperative increase in intraocular pressure one underwent successful trabeculectomy at the time of silicone oil removal, but the remaining four eyes required further topical and systemic treatment in order to maintain intraocular pressure below 25 mm Hg.

Retinal re-detachment occurred in three eyes, in each case associated with severe postoperative intraocular haemorrhage, active fibrovascular epiretinal membrane re-proliferation, and retinal breaks. One eye was deemed inoperable and the other two were re-attached with further epiretinal membrane dissection and re-injection of silicone oil. However severe epiretinal membrane re-proliferation occurred in one of these eyes resulting in an inoperable retinal detachment. All three eyes with re-detachment following silicone oil removal presented originally with a chronic combined traction and rhegmatogenous retinal detachment and very active fibrovascular membranes.

Ultimately the retina remained attached in 23 eyes (although one contained silicone oil), 11 eyes showing some evidence of epiretinal membrane re-proliferation and three having residual extramacular traction retinal detachment that remained stable. Of the seven eyes that remained phakic after silicone oil removal, three subsequently underwent cataract extraction. Posterior capsule thickening requiring Nd-YAG capsulotomy occurred in six eyes. The remaining four phakic eyes showed posterior subcapsular opacification.

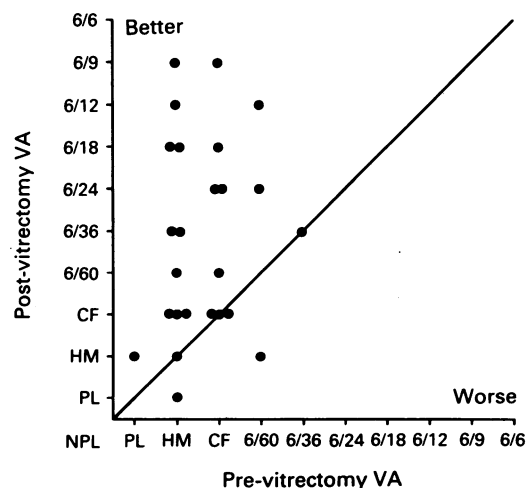
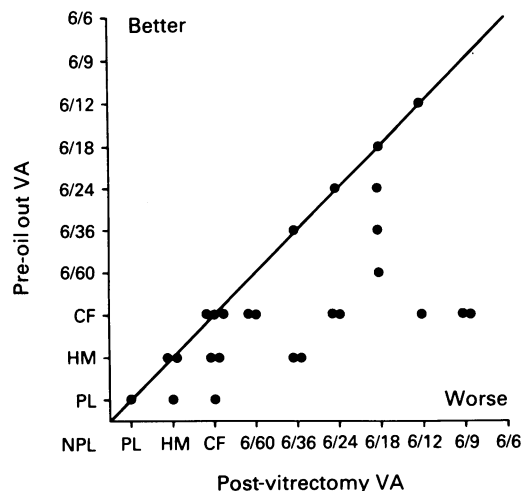


Figure 1 Change in visual acuity following the initial vitrectomy and silicone oil injection.

Figure 2 Change in visual acuity immediately before the removal of silicone oil.



The visual acuity improved after the initial vitrectomy and silicone oil injection in 18 (72%) eyes, remained unchanged in five (20%) eyes, and deteriorated in two (8%) eyes (Fig 1). The visual acuity decreased in 15 (60%) eyes before the removal of silicone oil, usually owing to the development of cataract, but remained unchanged in 10 (40%) (Fig 2). Following the removal of silicone oil and cataract surgery, the visual acuity improved in 19 eyes (76%), remained the same in five (20%), and deteriorated in one (4%) (Fig 3).

Discussion

Silicone oil is a useful surgical tool in retinal re-attachment surgery in patients with severe complications of PDR. However anterior segment complications occur in eyes with PDR just as they do in non-diabetic eyes. Cataract developed or advanced in all patients in this study either before or after the removal of silicone oil, although standard cataract surgery with or without posterior chamber implantation was successful whether at the time of silicone oil removal or at a later stage.

There was a relatively high incidence of increased intraocular pressure in the eyes studied which proved difficult to control even after the removal of silicone oil. Complications were also evident in the posterior segment both before and after the removal of silicone including epiretinal

membrane re-proliferation and traction detachment. It is generally accepted that it is not possible to fill 100% of the vitreous cavity with silicone and as the silicone is buoyant, the inferior retina remains in contact with aqueous. Theoretically, growth factors become effectively 'compartmentalised' by the silicone bubble thus encouraging the re-proliferation of epiretinal membranes.

The 12% incidence of retinal re-detachment following removal of silicone oil in this study (three out of 25 eyes) is lower than that previously reported in non-diabetic eyes.¹⁴⁻¹⁶ This may be partly due to the relatively low number of patients in our series, but there are pathophysiological differences between diabetic and non-diabetic eyes undergoing vitrectomy. In diabetic retinopathy the proliferative process is usually confined to the post-equatorial retina and retinal breaks (pre-existing or iatrogenic) tend to be posterior and thus more easily accessible to surgical relief of any associated vitreoretinal traction. In contrast in non-diabetic eyes the retinal breaks are usually in the retinal periphery and may be difficult to close permanently, especially if anterior proliferative vitreoretinopathy is present.¹⁹ Also the extensive scatter laser photocoagulation applied to all the eyes in this series may have helped to strengthen the retinal adhesion. Interestingly two of the three retinal detachments following removal of silicone oil showed extensive pre-equatorial fibrovascular proliferation, the surgical management of which is currently one of the most challenging problems of diabetic vitrectomy. All three eyes which suffered retinal re-detachment had a severe haemorrhage in the vitreous cavity on the first postoperative day. It may be argued that such patients are poor candidates for the removal of silicone particularly since spontaneous peripheral relieving retinotomies may occur in silicone filled eyes.²⁰

The eventual visual outcomes in this series are encouraging with most of the eyes recovering the visual acuity achieved soon after initial vitrectomy. The deterioration of vision before the removal of silicone oil was mainly due to the development of cataract, but the vision was restored once the silicone and the cataract had been removed.

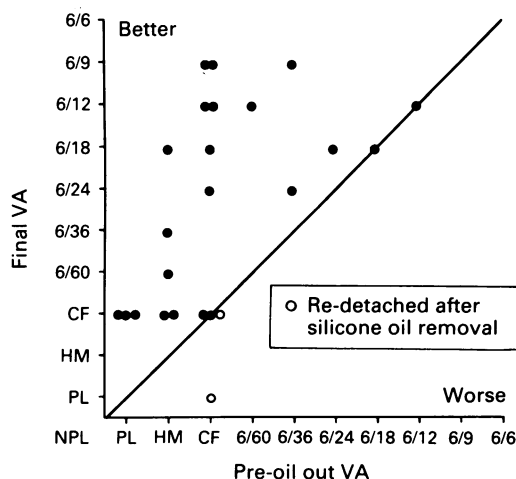


Figure 3 Change in visual acuity following the removal of silicone. Open circles signify persistent retinal re-detachment after the removal of silicone.

- Blankenship GW, Machemer R. Long term diabetic vitrectomy results. Report of a 10 year follow-up. *Ophthalmology* 1985; 92: 503-6.
- Rice TA, Michels RG. Long-term anatomic and functional results of vitrectomy for diabetic retinopathy. *Am J Ophthalmol* 1980; 90: 297-303.
- McLeod D. Silicone oil injection during closed microsurgery for diabetic retinal detachment. *Graefes Arch Clin Exp Ophthalmol* 1986; 224: 55-9.
- Yeo JH, Michels RG, Glaser BM. Silicone oil in the treatment of complicated retinal detachments. *Ophthalmology* 1987; 94: 1109-13.
- Leaver PK, Grey RHB, Garner A. Silicone oil injection in the treatment of massive preretinal retraction. II. Late complications in 93 eyes. *Br J Ophthalmol* 1979; 63: 361-7.
- Okun E. Intravitreal surgery utilising liquid silicone. *Trans Pacific Coast Oto-ophthalmol Soc* 1968; 49: 141-59.
- Haut J, Ullern M, Chernet M, Van Effenterre G. Complications of intraocular injections of silicone combined with vitrectomy. *Ophthalmologica* 1980; 180: 29-35.
- Kanski JJ, Daniel R. Intravitreal silicone injection in retinal detachment. *Br J Ophthalmol* 1973; 57: 542-5.
- Cockerham WD, Schepens CL, Freeman HM. Silicone injection in retinal detachment. *Arch Ophthalmol* 1970; 83: 704-12.
- McLeod D, James CR. Visco-delamination at the vitreoretinal juncture in severe diabetic eye disease. *Br J Ophthalmol* 1988; 72: 413-9.

- 11 Gonvers M. Temporary use of intraocular silicone oil in the treatment of detachment with massive periretinal proliferation. *Ophthalmologica* 1982; 184: 210-8.
- 12 Leaver PK, Lean JS. Management of giant retinal tears using vitrectomy and silicone oil/fluid exchange: a preliminary report. *Trans Ophthalmol Soc UK* 1981; 101: 189-91.
- 13 Casswell AG, Gregor ZJ. Silicone oil removal 1. The effect on the complications of silicone oil. *Br J Ophthalmol* 1987; 71: 893-7.
- 14 Casswell AG, Gregor ZJ. Silicone oil removal 2. Operative and postoperative complications. *Br J Ophthalmol* 1987; 71: 898-902.
- 15 McCuen BW II, de Juan E Jr, Landers MB III, Machemer R. Silicone oil in vitreoretinal surgery. 2. Results and complications. *Retina* 1985; 5: 198-205.
- 16 Zivojnovic R, Mertens DAE, Peperkamp E. Das flussige silikon in der amotiochirurgie. II. Bericht uber 280 falleweitere entwicklung der technik. *Klin Monatsbl Augenheilkd* 1982; 181: 444-52.
- 17 Michels RG. Vitrectomy for complications of diabetic retinopathy. *Arch Ophthalmol* 1978; 96: 237-46.
- 18 Leaver PK, Cooling RJ, Feretis EB, Lean JS, McLeod D. Vitrectomy and fluid/silicone-oil exchange for giant retinal tears: results at six months. *Br J Ophthalmol* 1984; 68: 432-8.
- 19 Charles S. *Vitreous microsurgery*. Baltimore: Williams & Wilkins, 1981: 124.
- 20 Wilson-Holt N, Gregor Z. Spontaneous relieving retinotomies in diabetic silicone filled eyes. *Eye* 1992; 6: 161-4.