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Primary vitrectomy without scleral buckling for rhegmatogenous retinal detachment

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Abstract ● Background: Pars plana vitrectomy has evolved as an alternative method in the treatment of more complicated rhegmatogenous retinal detachments. We report a series of patients who underwent primary vitrectomy with gas tamponade without the use of additional scleral buckling. ● Methods: A retrospective study of 53 patients with a follow-up of 6–45 months (mean 17.8 months) was carried out. Preoperative findings included unusual, multiple or large breaks, vitreous haemorrhage, proliferative vitreoretinopathy and bullous retinal detachment. Preoperative visual acuity was between light perception and 1.0, with 30% (16/53) of patients with 0.4 or better. ● Results: Retinal reattachment was achieved in 64% of cases (34/53) with one and in 92% (49/53) with one or more operations. Final visual acuity was between light perception and 1.0, with 41% (22/53) of patients with 0.4 or better. Cataract formation occurred in 86% (37/43) of all patients with a clear lens preoperatively. Macular pucker was noted in 11% (6/53) and postoperative proliferative vitreoretinopathy causing redetachment in 6% (3/53). ● Conclusion: With primary vitrectomy, a high final anatomical success rate with few intraoperative complications can be achieved in more complicated forms of rhegmatogenous retinal detachment. The major drawback of the procedure is the high incidence of postoperative cataract formation.

Introduction

Since its introduction by Machemer in the 1970s [14], pars plana vitrectomy has established itself in the treatment of complicated rhegmatogenous retinal detachment. To date several indications have been defined: retinal detachment complicated by dense media opacities (e.g. vitreous haemorrhage); proliferative vitreoretinopathy (PVR); giant retinal tears; and retinal detachment associated with holes at the posterior pole [18].

Even in less complicated forms of rhegmatogenous retinal detachment, pars plana vitrectomy seems to offer some advantages over scleral buckling procedures. Via the pars plana approach the causative vitreoretinal traction can be removed together with vitreous opacities; an internal drainage of subretinal fluid avoids the possible hazards of external drainage; a temporary internal gas tamponade can be installed; internal laser or cryocoagulation can be performed; and the risk of motility disorders, anisometropia or external infection caused by exoplants can be avoided in the majority of cases. On the other hand, pars plana vitrectomy carries its own risks and complications [26], and over 90% of routine retinal detachments can be treated successfully with scleral buckling procedures alone [1]. The indications for primary vitrectomy in non-proliferative rhegmatogenous retinal detachment, therefore, remain undefined [13, 17, 32, 35].

Since the first report by Klöti [10], several series of primary pars plana vitrectomy have been published [4, 5, 7, 9, 11, 16, 24, 30, 31, 33, 34]. However, in the majority

of cases vitrectomy has been combined with additional scleral buckling [5, 7, 16, 24, 31, 34]. The objective of this study is to report the results in a series of 53 patients treated with primary vitrectomy without additional scleral buckling.

Patients and methods

A retrospective analysis of 53 cases undergoing primary vitrectomy without additional scleral buckling at the University Eye Hospital, Essen (20 cases) and the University Hospital Benjamin Franklin, Berlin (33 cases) was carried out. Operations were performed between January 1992 and April 1994 by 5 surgeons (N.B., W.F., M.H.F., U.K. and H.H.). Final follow-up examinations were performed between 6 and 45 months postoperatively (median 13.8 months, mean 17.8 months).

Some 68% (36/53) of the patients were men and 32% (17/53) were women. The age of the patients ranged from 25 to 82 years (median 58.3 years, mean 55.8 years). In all cases the diagnosis of a rhegmatogenous retinal detachment was confirmed before or during surgery. Excluded from this series were patients with retinal detachment secondary to trauma, redetachments, cases in which no retinal hole could be found before or during surgery, patients with diabetes mellitus or a history of uveitis, and patients with a follow-up period of less than 6 months.

Preoperative refraction ranged from −16.0 to +0.5 diopters (dpt; median −2.75 dpt, one case of aphakia correction of +3.0 dpt). In 24% of all patients (13/53), myopia exceeded −6.0 dpt. Visual acuity was between light perception and 1.0, with 81% of patients (43/53) with 0.1 or better and 30% (16/53) with 0.4 or better. A single retinal hole could be found in 57% of patients (30/53), two or more holes in 43% (23/53). The locations of the holes were as follows: 67% in the upper temporal, 17% in the upper nasal, 8% in the lower temporal and 8% in the lower nasal quadrant. In 11% of patients (6/53), retinal holes could be detected below the 4 and 8 o'clock positions. The macula was attached in 55% of cases (29/53); in the remaining 45% (24/53), the macula was detached or partially detached. In 81% of all patients (43/53), a clear lens was noted preoperatively. Preoperative cataract formation could be observed in 13% of cases (7/53). Two patients had undergone cataract surgery with implantation of a posterior chamber lens; in one case of Marfan's syndrome, a lensectomy without implantation of an intraocular lens had been performed due to subluxation of the clear lens.

In two cases, scleral buckling surgery was interrupted and a primary vitrectomy was performed due to insufficient intraoperative reattachment. In one patient, photocoagulation of a retinal break had been performed before retinal detachment. Not included in this series were 36 cases of vitrectomy without additional buckling and a follow-up of less than 6 months, 21 patients in whom vitrectomy was combined with scleral buckling surgery and 12 in whom silicone oil was used for internal tamponade.

Indications

The decision for primary vitrectomy without scleral buckling was based on the surgeon's individual preferences. Preoperative findings included large retinal breaks, breaks with marked vitreous traction, unusual shape of breaks associated with lattice degeneration (see Fig. 1) or radial extension posterior to the equator, multiple retinal breaks, vitreous haemorrhage, bullous detachment, preoperative PVR and insufficient visibility of the fundus due to dense cataract or seconary cataract and miosis in pseudophakic eyes (Table 1).

Operation technique

In all cases, standard three-port vitrectomy with cryotherapy or laser treatment of retinal breaks and fluid-gas exchange was performed under general anaesthesia. In 42% of cases (22/53), the flap of the retinal break was removed. In 21% of cases (11/53) perfluordecalin or perfluoroctan was used to unfold the detached retina. In one case, a retinotomy for internal drainage of subretinal fluid was necessary. The retinal breaks were treated with exocryo in 57% of cases (30/53), endocryo in 24% (13/53), exo- and endocryo in 15% (8/53), exocryo and endolaser in 2% (1/53) and endolaser coagulation in 2% (1/53). After fluid-air exchange, a 30%–40% SF_6-air mixture was used for internal tamponade. In two cases with dense cataract, lensectomy was performed.

Results

Reattachment

After one operation, the retina was reattached at the final follow-up in 64% of all patients (34/53). The success rate was 89% (47/53) after two operations and 92% (49/53) after three operations. In a further three cases, the retina was attached at final examination with intraocular silicone oil tamponade; these cases were not included in the calculation of the final success rate. In one case, the retina remained partly detached despite a fourth surgical intervention due to severe PVR.

Redetachment after the first procedure was believed to be due to new or previously undetected retinal breaks in 74% of cases (14/19) (Fig. 2), to PVR in 16% (3/19) and to insufficiently closed breaks in 10% (2/19). Eighty-four per cent of redetachments (16/19) were diagnosed within the first 3 months after operation. The remaining three redetachments occurred 4, 12 and 42 months after the initial procedure. Preoperative findings of patients with redetachments are listed in Table 1.

Table 1 Preoperative and intraoperative findings in all patients and in patients with redetachment

Finding	All patients (n=53)	Redetachment (n=19)
Unusual break (marked vitreous traction, lattice degeneration)	68% (36/53)	63% (12/19)
Large breaks	60% (32/53)	58% (11/19)
Break extension posterior to equator	58% (31/53)	63% (12/19)
Single break	57% (30/53)	58% (11/19)
Macula attached	55% (29/53)	58% (11/19)
Macula detached	45% (24/53)	42% (8/19)
Multiple breaks	43% (23/53)	42% (8/19)
Vitreous haemorrhage	24% (13/53)	26% (5/19)
Myopia >−6.0 dpt	24% (13/53)	16% (3/19)
Bullous detachment	17% (9/53)	5% (1/19)
Breaks below 4 to 8 o'clock	11% (6/53)	16% (3/19)
Preoperative PVR	9% (5/53)	21% (4/19)

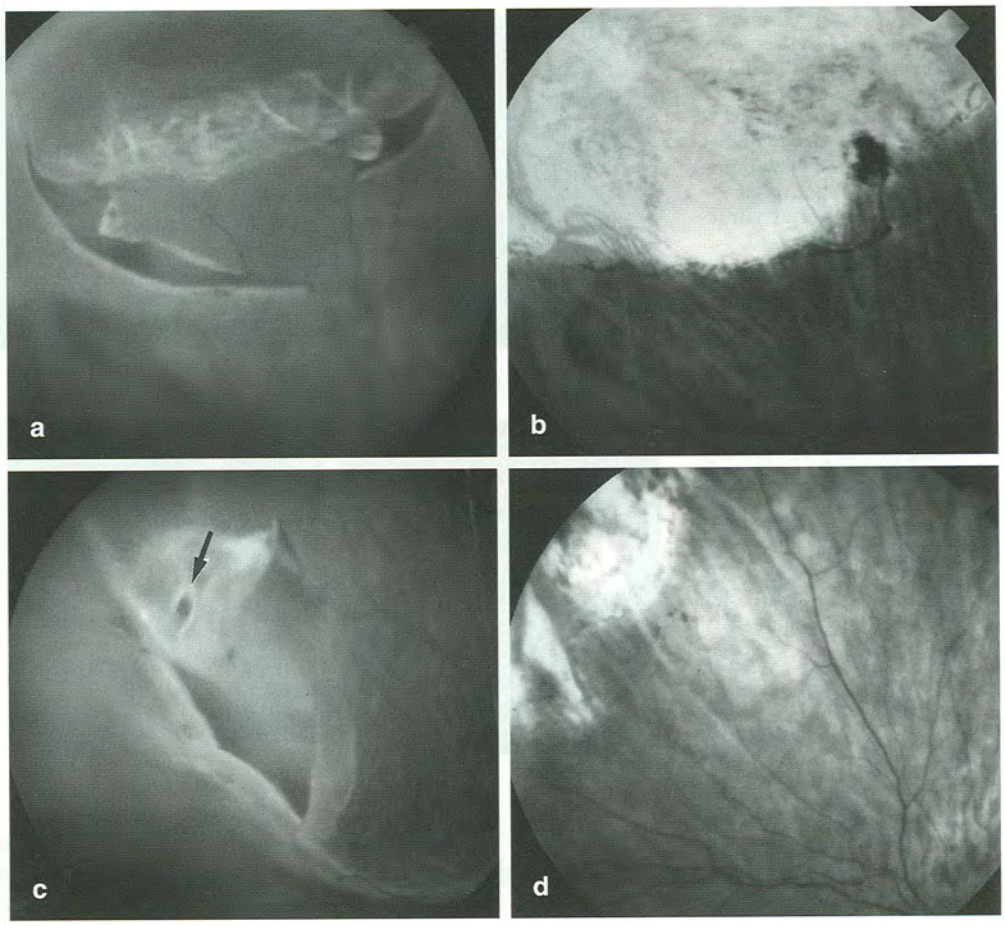

Fig. 1a–d Unusual retinal breaks. **a** Multiple breaks in association with lattice degeneration in myopia. **b** Chorioretinal scar 6 months after vitrectomy and cryocoagulation. **c** Break with marked vitreous traction and a second small hole in the flap of the break (*arrow*). **d** Chorioretinal scar 6 months after vitrectomy and cryocoagulation

Intraoperative complications

Intraoperative complications included one case of combined pre- and subretinal bleeding, probably due to rupture of a retinal vessel, during exocryo treatment. This complication occurred during scleral buckling surgery and the decision for vitrectomy was made following this complication. In two other cases, an iatrogenic retinal hole was created during intraocular manipulations. In one case, retinal incarceration in a sclerotomy site was noted. During one vitrectomy revision, a severe choroidal haemorrhage occurred which made a third intervention necessary.

Postoperative complications

In one case, a markedly elevated intraocular pressure necessitating partial drainage of intraocular gas was noted. New retinal holes that were treated with cryo- or laser coagulation occurred in 9% of patients (5/53); in two of these cases, a redetachment developed subsequently. In a further two of the five patients, occurrence of the new break followed redetachment surgery. Macular pucker occurred in 11% of patients (6/53), in three cases developing after redetachment surgery.

PVR causing retinal redetachment was noted in 6% of cases (3/53). In one patient, preretinal membranes with circumscribed wrinkling of the retinal surface could be seen but remained stable and did not lead to a redetachment during the follow-up period.

Of all patients with a clear lens preoperatively, 86% (37/43) developed a significant nuclear cataract during follow-up compared to the fellow eye and/or preoperative staging (Fig. 3); in 41% of these patients with significant postoperative cataracts (15/37), additional surgery for retinal redetachment had been performed during follow-up.

The median age of patients with a clear lens preoperatively was 55.3 years. Cataract formation could be noted in 71% of patients younger than 55 years (15/21) and in all patients older than that (22/22). In 28% of patients with a clear lens preoperatively (12/43), cataract surgery was performed during the follow-up period (in seven cases cataract surgery with implantation of an intraocular lens, in five cases lensectomy during redetachment intervention). All seven patients with preoperative cataracts underwent cataract surgery during follow-up (in two cas-

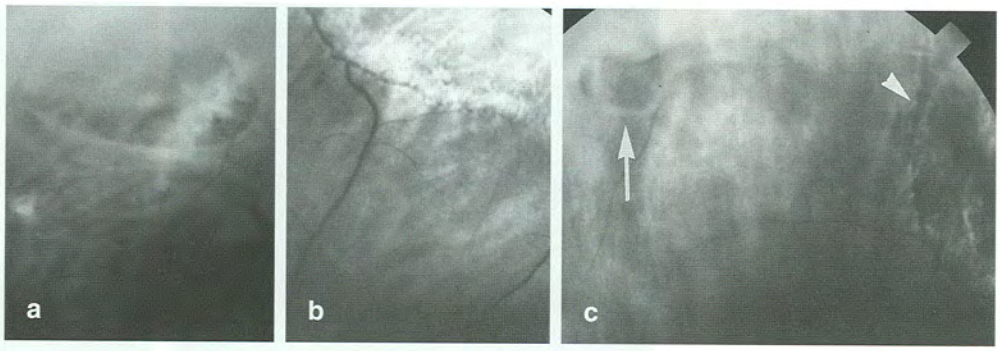

Fig. 2a–c New retinal break following primary vitrectomy. **a** Preoperative break in the upper temporal quadrant (left eye). **b** Chorioretinal scar 4 weeks after vitrectomy and cryocoagulation. **c** New break (*arrow*) in the upper nasal quadrant 4 weeks after vitrectomy. The area of the old break is marked by the *arrowhead*

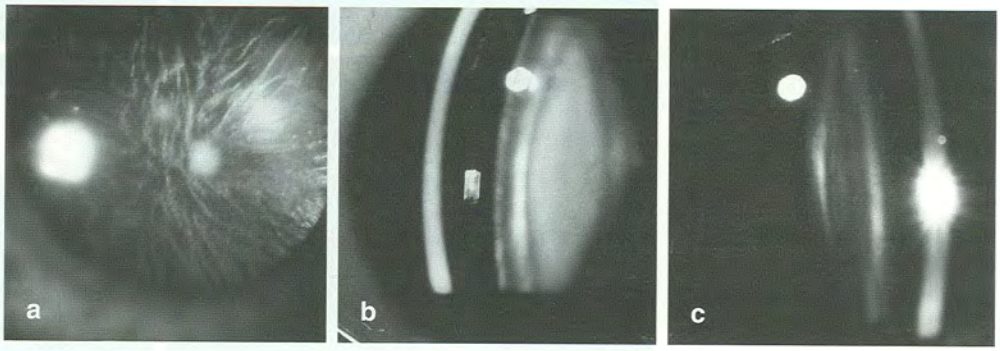

Fig. 3a–c Cataract formation following primary vitrectomy. **a** Subcapsular posterior cataract 2 days after surgery in a 52-year-old patient. **b** Nuclear cataract (right eye) 1 year after surgery in a 63-year-old patient. **c** Clear lens of the left eye of the same patient as **b**

es vitrectomy combined with lensectomy). The mean interval between vitrectomy and cataract surgery was 15.4 months.

Reoperation

Operations for redetachment included revision of vitrectomy with SF_6 tamponade in eight cases; vitrectomy revision, SF_6 tamponade plus encircling band in seven cases; encircling band or segmental episcleral buckle in two cases; and vitrectomy revision, silicone oil tamponade plus encircling band in two cases. Of six cases with a second redetachment, silicone oil tamponade plus encircling band was performed in four cases, gas tamponade in one case and an encircling band in one case. One retina remained partly detached despite a fourth intervention due to severe choroidal haemorrhage during the first reoperation and subsequent PVR. Silicone oil removal without further redetachment could be performed in three cases during the follow-up period.

Visual acuity

Postoperative visual acuity was between light perception and 1.0, with 75% of patients (40/53) with 0.1 or better and 41% (22/53) with 0.4 or better. Details of visual acuity according to pre- and postoperative characteristics are listed in Table 2 and displayed in Fig. 4. Visual acuity of less than 0.1 occurred in 25% (13/53) of all patients. This was thought to be due to a combination of dense cataract and macular dysfunction in five cases, to dense cataract in two cases, to pre-existing macular degeneration in two cases, to macular pucker in one case and to persistent retinal detachment in one case. In two cases, no obvious reason for a visual acuity of less than 0.1 could be detected.

In 15 of 18 patients with a visual acuity between 0.1 and 0.4, nuclear cataract was judged to be the main factor responsible for decreased visual acuity; further reasons for a decreased acuity included presumed macular dysfunction in two cases with retinal redetachment, one case of macular pucker and one case of amblyopia.

Table 2 Proportion of patients with postoperative visual acuities of 0.1 or better and 0.4 or better

Patients	*n*	Postoperative visual acuity	
		≥0.1	≥0.4
All patients	53	75% (40/53)	41% (22/53)
Phakic at final examination	31	71% (22/31)	29% (9/31)
Cataract surgery	22	77% (17/22)	59% (13/22)
Macula attached	29	83% (24/29)	38% (11/29)
Macula detached	24	67% (16/24)	46% (11/24)
No redetachment	34	91% (31/34)	56% (19/34)
Redetachment	19	47% (9/19)	16% (3/19)

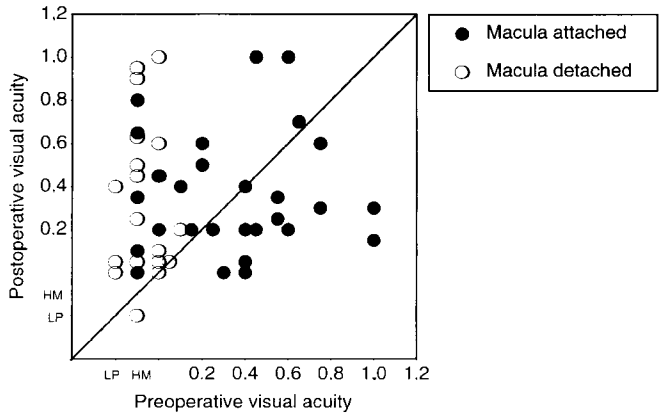

Fig. 4 Preoperative versus postoperative visual acuity in all 53 patients (*LP* light perception, *HM* hand movements)

Discussion

Scleral buckling surgery is the treatment of choice in the majority of cases of rhegmatogenous retinal detachment [1, 35]. In order to improve the outcome of more complicated types of rhegmatogenous retinal detachment without preoperative PVR, primary vitrectomy was introduced by Klöti as an alternative to scleral buckling in these situations [10]. Since then, several studies of primary vitrectomy have been published (Table 3) [4, 5, 7, 9, 11, 16, 24, 30, 31, 33, 34].

In our series of 53 patients the reattachment rate was 64% (34/53) after one procedure and 92% (49/53) after one or more operations. The primary success rate is comparable to the results of Hakin et al. [7] but worse than reported in other studies of primary vitrectomy (Table 3). The reason for this could be the inclusion of more complicated types of retinal detachments (e.g. preoperative PVR and vitreous haemorrhage) or the avoidance of additional scleral buckling in our series. The final reattachment rate of 92% (49/53) compares favourably with the results published by other authors (Table 3).

In comparison, the primary success rates of scleral buckling surgery range from 72% [29] in consecutive unselected cases to 96% [22] in relatively uncomplicated situations. In recent series, higher primary success rates of 78 to 94% with final success rates of 86 to 90% are reported [8, 15, 25]. However, more complicated cases of retinal detachment with a higher risk of postoperative complications were excluded from these series and were treated with vitrectomy.

The postoperative complications observed in the present series included retinal redetachment, PVR, new retinal holes, macular pucker and cataract formation. The major reason for retinal redetachment overall was the formation of new retinal breaks. Although the differentiation between new or previously missed breaks cannot be made in all cases, we had the impression, documented in some cases (Fig. 2), that the retinal breaks that led to redetachment developed after the first intervention. New retinal breaks are a known complication of vitrectomy for other reasons and are believed to be secondary to traction of remnant vitreous [18]. The comparatively higher incidence of new retinal breaks after pneumatic retinopexy and the lower incidence after scleral buckling surgery [17] suggests that the intraocular gas tamponade might be an important factor in the formation of new retinal breaks. The incidence has been lower in other studies of primary vitrectomy than in ours [4, 5, 7]. One possible explanation could be the high proportion of cases featuring additional scleral buckling which possibly relieves traction of remnant vitreous that could lead to new break formation. However, no major differences can be found comparing the reattachment-rates of primary vitrectomy with additional scleral buckling [5, 7, 31, 33] and without scleral buckling [5, 7, 9, 30] published to date.

The most important complication of rhegmatogenous retinal detachment is postoperative PVR, not only leading to redetachment but also causing relatively poor final visual acuity in a large number of cases [1, 20]. Cowley et al. state that the use of vitrectomy in the management of retinal detachment was the strongest risk factor for the development of postoperative PVR in a series of 607 cases [3]. However, as Hakin et al. argued, in 50% of those cases reported by Cowley and colleagues, preoperative PVR formation was noted, which in itself would be a major risk factor for postoperative PVR formation [7]. In contrast to Cowley's opinion, one could assume that the removal of the vitreous scaffolding would reduce the incidence of postoperative PVR after retinal detachment [7]. The reported incidence of PVR following primary vitrectomy varies between 8% [5] and 20% [7] (Table 3). The reported incidence of PVR after scleral buckling procedures is about 5–10% [2, 6, 20, 23, 25, 29]. In a recently published series of 1020 patients operated on mainly with scleral buckling techniques, 10% developed severe postoperative PVR, suggesting that the improvement of scleral buckling techniques might not have resulted in a lower incidence of PVR [6]. With the data available, it does not seem possible to define whether there is a higher or lower incidence of PVR following primary vitrectomy than after scleral buckling surgery.

One of the arguments for primary vitrectomy is that better postoperative visual function (albeit possibly at the cost of additional cataract surgery) is achieved [4]. In our series, 75% of all patients (40/53) achieved visual acuity of 0.1 or better and 41% (22/53) of 0.4 or better. Final visual acuity was influenced by several pre- and postoperative factors (Table 2). The most important reason for decreased postoperative visual acuity was nuclear cataract formation, followed by presumed macular dysfunction due to retinal and macular redetachment or

Table 3 Studies of primary vitrectomy in rhegmatogenous retinal detachment (*PVR* proliferative vitreoretinopathy)

Publication	Preoperative characteristics	Follow-up (months)	*n*	Tamponade	Buckling	Visual acuity		Primary success	Final success	PVR
						≥0.3	≥0.4			
Escoffery et al. 1985 [4]	Breaks posterior to the equator, unusual and large breaks, retinoschisis	≥6	29	Air	0%		81%	79%	93%	7%
Verbraeken et al. 1986 [31]	Aphakic and pseudophakic detachments	≥6	82	silicone in 10%	100%		40%>0.5		87%	11%
Wong et al. 1987 [33]	Unseen holes, vitreous haemorrhage	6–36	47	SF_6, silicone	100%			59%		
Van Effenterre et al. 1987 [30]	Breaks above the horizontal meridian incl. macular holes, trauma, large breaks		60	SF_6	0%			82%	92%	0%
Rosen et al. 1989 [24]	Unseen holes, incl. redetachment, pseudophakia, vitreous haemorrhage, macular holes	≥1	78	Air, SF_6, silicone	98%			82%	85%	
Knaflic and Mester 1990 [11]	Rhegmatogenous detachment		72	SF_6		29%	20%	79%	84%	
Wong et al. 1992 [34]	Bullous detachment	≥6	97	Air	100%	80%		85%	97%	
Hakin et al. 1993 [7]	Breaks posterior to the equator, unusual, large and multiple breaks, unseen holes, vitreous haemorrhage	6–60	124	SF_6, C_3F_8, silicone	79%	34%		64%	83%	
Gartry et al. 1993 [5]	Breaks posterior to the equator, unusual, large and multiple breaks, unseen holes, vitreous haemorrhage, incl. redetachment	12–48	114	SF_6, propane	65%	25%		74%	92%	9%
Höing et al. 1995 [9]	Breaks posterior to the equator, unusual, large and multiple breaks, unseen holes, vitreous haemorrhage	6–18	32	SF_6	0%		41%	78%	94%	19%
Heimann et al. 1996 (this series)	Breaks posterior to the equator, unusual, large and multiple breaks, vitreous haemorrhage, PVR	6–45	53	SF_6	0%		41%	64%	92%	6%

macular pucker. The results for visual acuity obtained in the present study are comparable to those of previous studies of primary vitrectomy (Table 3) except those reported by Escoffery et al. [4]. In interpreting the latter's results, one has to consider that patients with redetachments were not included in the interpretation of functional results.

In the studies of scleral buckling surgery summarised by Michels et al. [19], visual acuity of 0.4 or better was achieved in 37–56% of patients. In recent reports, this value is reached in 79% [22] to 84% [8] of cases, probably due to the exclusion of more complicated cases and the higher anatomical success rates. Since there are not matching groups being operated on by either scleral buckling or primary vitrectomy, no differences between the levels of postoperative visual acuity can be outlined that would speak in favour of one of the two methods.

The major drawback of primary vitrectomy in the present series was the high incidence of postoperative nuclear cataract formation, which could be noted in 86% of all 43 phakic patients with a clear lens preoperatively. Cataract formation has been recorded as a complication of vitrectomy since the introduction of this technique [14, 26, 27]. In contrast, retinopexy with SF_6 injection has been shown not to increase the rate of postoperative cataract formation compared to the fellow eye 2 years postoperatively [21]. The removal of the retrolental vitreous with direct gas/lens contact seems to be a major factor determining postoperative cataract formation after primary vitrectomy. The choice of vitreous substitute is also important. Silicone oil tamponade carries a higher risk of cataract formation than SF_6 or balanced salt solution [12]. However, it is not clear whether the choice of gas or the concentration of the currently used SF_6-air and C_3F_8-air mixtures significantly influences the rate of cataract formation following vitrectomy.

Cataract formation after primary vitrectomy has been noted by other authors in 20% [7] and 23% [30] of patients. Although the rate of cataract formation after scleral buckling surgery in comparable situations cannot be estimated, and significant cataract formation following scleral buckling surgery has been documented [28], we think that primary vitrectomy carries a higher risk of postoperative lens changes that significantly interfere with good postoperative vision.

Postoperative cataract formation in this series occurred in all 22 patients older than 55 years with a clear lens preoperatively. The patient undergoing vitrectomy therefore has to be informed of the probability of a second operation to improve postoperative visual acuity following primary vitrectomy. Further, it should be discussed whether combined cataract surgery and vitrectomy should be performed in older patients with moderate lens changes, as significant postoperative nuclear sclerosis is highly likely to occur and a second operation is less well tolerated than in younger patients.

In conclusion, this series demonstrates that more complicated forms of rhegmatogenous retinal detachments can be treated successfully with primary vitrectomy without the need for additional scleral buckling. The advantages of this technique are the high final anatomical success rate (92%) and the low incidence of intraoperative complications. The major disadvantage is the high incidence of postoperative cataract formation.

One of the reasons for the increasing use of primary vitrectomy in rhegmatogenous retinal detachment might be surgeons' increasing experience of this technique for other vitreoretinal diseases and the better intraoperative control of the intraocular situation, especially in more complicated cases. However, these advantages would not justify primary vitrectomy if results similar to scleral buckling techniques were achieved, as cataract formation is a significant disadvantage of vitrectomy in phakic patients. As suggested by Leaver, only a controlled, prospective, randomised study will enable vitreoretinal surgeons to decide which are the best methods of treating different types of rhegmatogenous retinal detachment [13].

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