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CLINICAL STUDY

Scleral-fixated posterior chamber intraocular lenses in nonvitrectomised eyes

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Abstract

Objective **To assess the long-term outcome of scleral-fixated sutured posterior chamber intraocular lens (SPCIOL) implantation in non pars plana vitrectomised eyes (1) to evaluate the long-term visual outcome, (2) to identify preoperative risk factors for poor visual outcomes, and (3) to identify the incidence of vitreoretinal complications.**

Method **A retrospective review of 65 eyes, which had not undergone pars plana vitrectomy prior to scleral-fixated SPCIOL implantation.**

Results **In all, 65 eyes of 61 patients were analysed. The median follow-up period was 16 months (range 1–68 months). At final follow-up, 43 (66%) eyes had unchanged or improved BCVA at final follow-up. A total of 20 (31%) eyes had at least a two line improvement and eight (12%) eyes had at least a two line deterioration in final BCVA. No significant preoperative risk factors for a poor visual outcome were identified. In all, 24 eyes (37%) had per- and postoperative adverse events. These eyes were significantly more likely to have a poor visual outcome. Three eyes (4.6%) had a retinal detachment in the postoperative period, all of which had no perception of light at final follow-up.**

Conclusions **This study confirmed that while scleral-fixated SPCIOL intraocular lens implantation might be beneficial, there is a significant risk of per- and postoperative complications leading to loss of best-corrected vision in some eyes.**

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Introduction

Intracapsular posterior chamber intraocular lens implantation is the universally preferred method of aphakic correction following cataract removal. In the absence of sufficient capsular support, anterior chamber, iris-fixated, or sutured posterior chamber intraocular lenses (SPCIOL) can be used. SPCIOL were developed, and gained popularity, at around the same time that closed loop anterior chamber intraocular lenses were criticised following reports of high incidences of complications.[1] However, anterior chamber intraocular lens (ACIOL) implantation has come back into favour with the development of the modern multiflex open looped ACIOL, which have been shown to have lower complication rates.[2] ACIOL implantation requires less surgical time and is less invasive compared to implantation of SPCIOLs. Although there is no robust evidence of the superiority of SPCIOL over the open loop ACIOL, some surgeons prefer SPCIOLs to ACIOLs on the assumption that glaucoma, macular oedema, and other complications occur less frequently with posterior chamber intraocular lens implantation.[3] Concern also remains that open loop ACIOLs may still result in greater long-term damage to the corneal endothelium than SPCIOLs.

Schein *et al*[3] reported a randomised trial of open looped ACIOL, iris-fixated SPCIOL, and scleral-fixated SPCIOL at the time of penetrating keratoplasty. They found a greater complication rate for scleral compared to iris-fixated SPCIOL while ACIOL carried an intermediate risk. In three retrospective uncontrolled comparative studies of open looped ACIOLs with SPCIOLs,[4–6] no differences in clinical outcome were noted. Results of other series of SPCIOL with scleral fixation have also been published.

Scleral fixation techniques require passage of sutures and manipulation of intraocular lens haptics near the vitreous base. Several studies advocated pars plana vitrectomy with removal of as much anterior vitreous as possible prior to SPCIOL implantation to prevent vitreous entwinement around the lens haptic and suture site, which may result in retinal breaks from vitreous traction.[7] The studies of SPCIOL implantation outlined above did not specifically address the vitreous status of the eyes involved.

This study reviews the long-term outcome of eyes, which had not undergone pars plana vitrectomy prior to SPCIOL implantation to evaluate (1) the long-term outcome of SPCIOL implantation, (2) preoperative risk factors for poor visual outcome, and (3) the incidence of vitreoretinal complications.

Patients and methods

All procedures involving SPCIOL implantation between September 1992 and June 2000 at Moorfields Eye Hospital were identified from the operating theatre records. A total of 84 eyes were identified. Ten eyes had pars plana vitrectomy before SPCIOL implantation and were excluded. Nine case notes were not traceable. Pre- and postoperative clinical information, and surgical details were obtained from the case notes. There was no defined criteria for the diagnoses of glaucoma at the time of the study. This was based on the examining surgeons' criteria. At follow-up visits, best-corrected visual acuities (BCVA) were recorded using a Snellen visual acuity chart with either spectacle or contact lens correction at the preoperative visit and either unaided or with spectacle correction at follow-up visits.

Scleral IOL suture fixation techniques were used in all 65 procedures. The surgical technique has been described elsewhere[8] but in brief; fornix-based conjunctival flaps were created 180 degrees apart. Partial thickness triangular scleral flaps (46 eyes) or scleral grooves (19 eyes) were fashioned to prevent exposure of the suture knots. Scleral fixation sutures, using 10/0 polypropylene sutures, were inserted using an *ab externo* technique (60 eyes) or an *ab interno* technique (five eyes). Anterior vitrectomy was performed when considered necessary by the operating surgeon. The Alcon CZ70BD one piece PMMA lens with a 7 mm diameter optic and suturing eyelets on the haptics was used in all cases except in 12 eyes where the Bausch and Lomb IOLAB 6840U was used, and in three eyes where the aniridic Morcher Type 67F Sundmacher lens was used. Concurrent procedures were performed in the appropriate sequence as judged by the operating surgeon.

The eyes that had undergone SPCIOL implantation were analysed as two groups according to whether or not they had at least a two line deterioration in visual acuity. Logistic regression was then conducted to examine evidence of any association between any of the putative risk factors and the likelihood of a poor outcome.

Results

In all, 65 eyes of 61 patients, 32 males and 29 females, who underwent SPCIOL implantation were analysed. The mean age at the time of SPCIOL implantation was 58.8 years (SD 18.2 years). The median follow-up period was 16 months (range 1–68 months). Table 1 shows the aetiology of aphakia and additional procedures that were performed concurrently during SPCIOL implantation. In all, 19 eyes had pre-existing glaucoma. Four eyes had pre-existing corneal grafts. A total of 48 eyes required anterior vitrectomy. None of the eyes had pars plana vitrectomy at any time except one eye, which underwent retinal detachment surgery in the postoperative period.

The preoperative and final BCVA for all eyes in this series are shown in Figure 1. In all, 43 (66%) eyes had unchanged or improved BCVA at final follow-up. In all, 20 (31%) eyes had at least a two line improvement and eight (12%) eyes had at least a two line deterioration in final BCVA. Clinical characteristics of six of these eight eyes are shown in Table 2, which documents adverse events. The other two eyes had: (a) severe blunt trauma and intracapsular cataract surgery, and BCVA before SPCIOL implantation was 6/6 with contact lenses but the patient was contact lens intolerant. BCVA at final follow-up was 6/12 with spectacles, and (b) a broad iridectomy and ACIOL following complicated cataract surgery. The patient had intolerable glare. The ACIOL was replaced

Table 1 Aetiology of aphakia and additional procedures that were performed concurrently during SPCIOL implantation

	No. of eyes
Aetiology of aphakia	
Complicated cataract extraction	19
Planned intracapsular cataract extraction	14
Subluxated lens extraction	8
Pseudophakic bullous keratoplasty with intraocular lens explantation	5
Previous severe trauma	17
Other	2
Concurrent procedures	
Cataract extraction	14
Removal of intraocular lens	12
Penetrating keratoplasty	20
Insertion of Morcher aniridic lens	3
Trabeculectomy	2
Iridoplasty	2
None	27

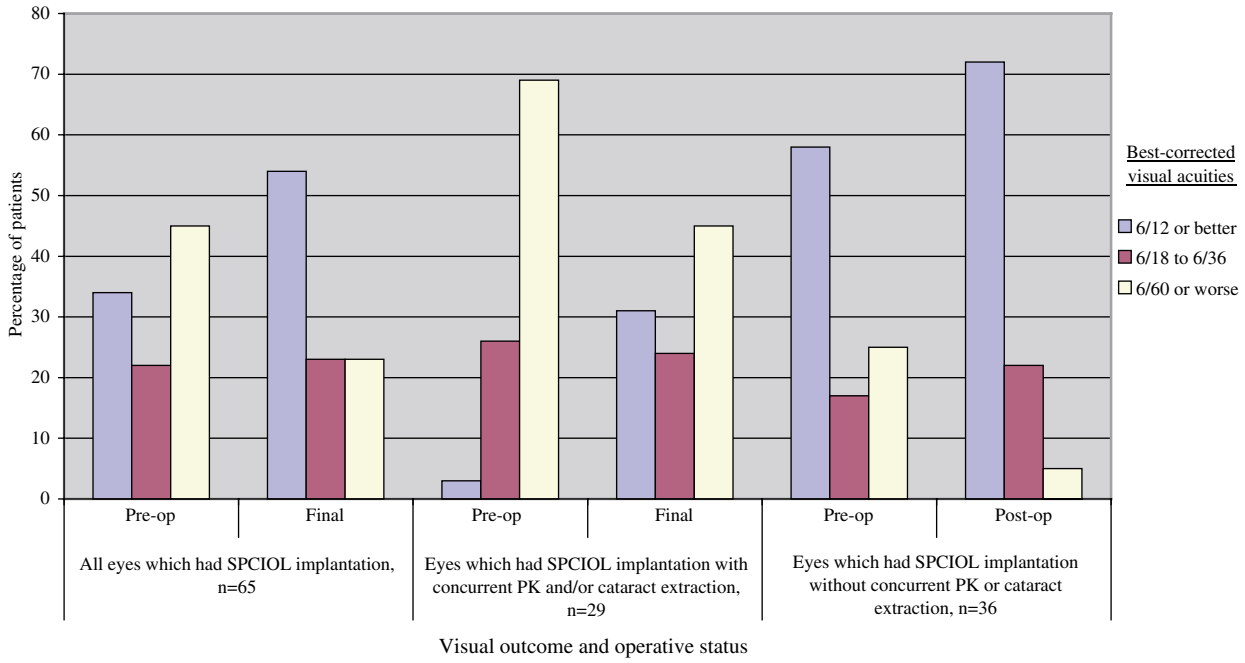

Figure 1 Preoperative and final visual outcome in eyes that underwent SPCIOL implantation, SPCIOL implantation with concurrent PK and/or cataract extraction, and SPCIOL implantation without concurrent PK or cataract extraction.

with a sutured scleral-fixated aniridic Morcher Type 67F Sundmacher lens. BCVA was 6/9 before the procedure and 6/18 at final follow-up. The glare was markedly improved.

The preoperative and final BCVA for eyes, that underwent concurrent penetrating keratoplasty and/or cataract extraction during SPCIOL implantation and eyes that did not undergo these concurrent procedures are also shown in Figure 1. In eyes that underwent concurrent penetrating keratoplasty and/or cataract extraction, 14 of 29 (48%) eyes had improved BCVA at final follow-up while in seven (24%) eyes, the final BCVA was unchanged. Four (14%) eyes in this group suffered at least a two line deterioration in BCVA at final follow-up. In eyes that did not undergo these concurrent procedures, 17 of 36 (47%) eyes had improved BCVA at final follow-up, while in five (14%) eyes, the final BCVA was unchanged. Four (11%) eyes in this group suffered at least a two line deterioration in BCVA at final follow-up.

Table 2 documents the clinical characteristics of the 24 eyes that had per- and postoperative adverse events. Table 3 shows the number of eyes with each adverse event. Three eyes (4.6%) had retinal detachment in the postoperative period. Two eyes were considered inoperable, and one eye underwent unsuccessful retinal detachment surgery. All three eyes had no perception of light (NPL) at final follow-up. Four eyes had peroperative intraocular haemorrhage. All resolved spontaneously. Two of the eyes with fixation suture exposure required scleral patch grafting, and the third resolved spontaneously. Elevated IOP requiring intervention occurred in 16% (3/19) of eyes with pre-existing glaucoma and 13% (6/46) of eyes that did not have pre-existing glaucoma. Of the 24 eyes that had corneal grafts, rejection episodes occurred in seven (30%) eyes and 11 (46%) grafts decompensated. The presence of pre- and postoperative cystoid macular oedema was not consistently recorded in the case notes. In many eyes, corneal clarity was insufficient for accurate clinical diagnosis of cystoid macular oedema. Fundus fluorescein angiography was not undertaken.

Table 4 demonstrates that there was little evidence of any association between the likelihood of a poor visual outcome (at least a two line deterioration in BCVA at final follow-up) and increased age, glaucoma, severe trauma, previous or concurrent complicated cataract extraction, previous planned intracapsular cataract extraction and concurrent penetrating keratoplasty. These data however provide strong evidence ($P = 0.03$) that patients who had at least one adverse event were more likely to have a poor visual outcome than those who did not have any adverse event. Multivariate risk factor analysis was not performed due to the relatively low numbers in the study.

Discussion

The goal of SPCIOL implantation is to achieve refractive correction in eyes with insufficient capsular support without the need for aphakic spectacles or contact lenses.

Table 2 A summary of the clinical characteristics of the 24 eyes that were associated with adverse event(s) occurring in the per- and postoperative period

Age	*FU*	*Preop glaucoma*	*Cause of aphakia*	*Concurrent procedures*	*Preop BCVA*	*Final FU BCVA*	*Case summary of unfavourable intra- and postoperative events*
84	13	POAG	Complicated ECCE	Nil	6/60	6/18	Postoperative cystoid macular oedema
66[a]	32	POAG	Complicated ECCE	Nil	6/60	NPL	Elevated IOP requiring four cyclodiode treatments
86	16	Uveitic	Complicated ECCE	Nil	6/18	6/24	Inferiorly displaced sutured posterior chamber intraocular lens with recurrent uveitis
62	16	Nil	ICCE	Nil	CF	6/9	Suture exposure requiring scleral patch graft
48[a]	3	Nil	ICCE	Nil	6/60	NPL	Wound leak, hypotony, choroidal effusion, retinal detachment, graft rejection
67	19	OHT	ICCE	Nil	6/9	6/9	Suprachoroidal haemorrhage, elevated postop IOP requiring one cyclodiode treatment
70[a]	65	Nil	Complicated ECCE	ECCE	CF	NPL	Retina detachment–underwent surgery, redetachment with PVR
80	7	POAG	Complicated ECCE	ECCE	6/24	6/24	Postoperative epiretinal retinal membrane
48	46	Nil	Severe trauma	ECCE	CF	HM	Elevated postop IOP—medical treatment, decompensated graft
62	68	Nil	Complicated ECCE	IOLR	6/24	6/24	Elevated postop IOP—trabeculectomy, two decompensated grafts
68	54	POAG	Complicated ECCE	IOLR	6/36	6/24	Postoperative epiretinal membrane
75	10	Nil	Complicated ECCE	PK	CF	6/60	Elevated postop IOP—trabeculectomy, graft rejection, decompensated graft
63[a]	68	Aphakic	Complicated ECCE	PK	6/60	HM	Graft rejection episodes and two decompensated grafts
93	23	Nil	ICCE	PK	6/36	6/18	Suture exposure, resolved spontaneously
80	47	Aphakic	ICCE	PK	HM	PL	Graft rejection episodes and two decompensated grafts
38	6	Nil	Severe trauma	PK	6/60	CF	Elevated postop IOP requiring one cyclodiode treatment, phthisical eye
13	25	Nil	Severe trauma	PK	CF	CF	Intraoperative vitreous haemorrhage, graft rejection, decompensated graft
36[a]	28	Traumatic	Severe trauma	PK	6/36	HM	Elevated postop IOP-obstructed molteno tube than hypotony with choroidal effusion
60	8	Nil	Complicated ECCE	PK + ECCE	HM	HM	Hypotony and intraocular inflammation, decompensated graft on FU (preoperative acanthamoeba keratitis)
47	16	Nil	Severe trauma	PK + IR	CF	6/18	Graft rejection episodes with early graft decompensation
38[a]	24	Aniridia	Aniridia	PK + IOLR	6/60	NPL	Intraoperative vitreous haemorrhage, elevated postop IOP-obstructed molteno tube, decompensated graft, retinal detachment, phthisical eye
68	49	Nil	Pseudophakic BK	PK + IOLR	CF	CF	Graft rejection episodes, decompensated graft
80	46	Nil	Pseudophakic BK	PK + IOLR	HM	PL	Intraoperative vitreous haemorrhage, elevated postop IOP requiring one cyclodiode treatment, decompensated graft
79	15	Nil	Pseudophakic BK	PK + IOLR	6/60	6/36	Suture exposure requiring scleral patch graft

IR: iridoplasty; Ukn: unknown; POAG: primary open angle glaucoma; FU: duration of follow-up in months; HM: hand movement; PK: penetrating keratoplasty; ECCE: extracapsular cataract extraction; OHT: ocular hypertension; IOP: intraocular pressure; NPL: no perception of light; IOLR: removal of Intraocular lens; PL: perception of light; CF: count finger; ICCE: intracapsular cataract extraction.
[a]Eyes with two or more Snellen line visual deterioration at final follow-up.

Table 3 Number of eyes with each adverse event

Adverse events	*No. of eyes*
Elevated IOP requiring intervention	9
Decompensated corneal graft	13
Retinal detachment	3
Vitreous/iris haemorrhage	3
Suprachoroidal haemorrhage	1
Suture exposure	3
Cystoid macular oedema	1
Epiretinal membrane	2
Recurrent uveitis	1
None	41

IOP: intraocular pressure.

Table 4 Odds ratios for poor visual outcome (at least a two line deterioration of BCVA at final follow-up)

Study factor	*Odds ratio*	*95% CI*	P-*value*
Age	1.0	(0.96, 1.05)	0.81
Glaucoma	2.8	(0.62, 12.62)	0.18
Severe trauma	0.93	(0.17, 5.14)	0.94
Previous or concurrent ECCE	2.8	(0.62, 12.62)	0.18
Previous planned ICCE	0.48	(0.05, 4.30)	0.51
Concurrent PK	1.4	(0.30, 6.58)	0.66
Adverse event	6.5	(1.19, 35.4)	0.03

ECCE: extracapsular cataract extraction; ICCE: intracapsular cataract extraction; PK: penetrating keratoplasty.

In eyes that did not undergo concurrent penetrating keratoplasty or cataract extraction, maintaining BCVA at final follow-up without the need for aphakic spectacles or contact lenses constitutes the achievement of this goal. In patients who are intolerant of contact lens wear or aphakic spectacles, a slight deterioration in final BCVA may be an acceptable outcome. In this series, 89% of such eyes achieved improved, unchanged, or only a one line deterioration in BCVA at final follow-up without the need for aphakic spectacles or contact lenses. Uthoff *et al*[9] reported improvement or unchanged BCVA in 92% of eyes 1 year after SPCIOL implantation with 8% of eyes losing one to two lines of BCVA.

If penetrating keratoplasty and/or cataract extraction was performed concurrently with SPCIOL implantation, the goal of the combined procedures is to improve BCVA without the need for aphakic spectacles or contact lenses. In this series, 48% of the eyes ($n = 29$) which underwent concurrent penetrating keratoplasty or cataract extraction had improved BCVA at final follow-up. Direct comparison of our visual results with those of other series was difficult. Heidemann *et al*[10] reported better postoperative than preoperative visual acuity in 82% and deterioration in 3.6% of their patients. Best spectacle-corrected visual acuity was used to measure vision at the last follow-up but there was no detail of how preoperative visual acuity was measured. Comparison of uncorrected preoperative visual acuity against best spectacle-corrected postoperative visual acuity would increase the proportion of patients with improved visual acuity, thus exaggerating the effect of surgery on visual improvement. Furthermore, 37% of his cohort had less than 1 year of follow-up. Other studies[11,12] documented proportions of their cohorts' pre- and postoperative visual acuity but it is not possible from these data to determine the percentage of patients who had improved, unchanged or worse visual outcome.

In patients who had combined pars plana vitrectomy and SPCIOL implantation,[8] the final visual outcome appears better than in this study cohort with 76% achieving 6/12 or better vision and only one eye losing more than one Snellen line of vision at final follow-up. The patient cohort in this study, however, had less complex preoperative pathology, for example, about 40% of the cohort had SPCIOL implantation for ectopia lentis and none of the cohort required penetrating keratoplasty at any time. This difference in baseline patient characteristics, rather than differences in surgical technique, probably accounts for the differences in visual outcomes.

A total of 24 (37%) eyes suffered at least one adverse event (Table 2). In all, 17 (71%) of these eyes achieved no visual improvement and six of the eight (75%) eyes that had at least a two line deterioration in visual acuity at final follow-up had suffered one or more adverse events. While the individual preoperative clinical characteristics in this study could not be shown to have a significant effect in determining a poor visual outcome, the occurrence of adverse events in the per- and postoperative period was found to be a significant predictor of a poor outcome. Owing to the heterogeneity of the clinical characteristics and the size of this cohort, it was not possible to identify a significant preoperative risk factor for adverse events. Non significance in this series cannot be taken as proof of no difference because of the low power of this study to identify preoperative risk factors.

The rate of retinal detachment in our study was 4.6% (3/65) compared to rates of 1.1–4.9% in other series of SPCIOL implantation without pars plana vitrectomy.[9–14] The retinal detachment rate in this study is comparable to the rate of 3.2% found in a previous study in eyes that underwent complete pars plana vitrectomy at the time of SPCIOL implantation.[8] Comparison of these two series may, however, be misleading, the previous series being largely eyes with uncomplicated ectopia lentis or aphakia following trauma unlike the more heterogeneous aetiology of aphakia in the current study. The incidence of retinal detachment in this series appears to support the

view that with careful case selection, pars plana vitrectomy is not necessary in all eyes undergoing SPCIOL implantation.

In this study, two of the three eyes with retinal detachment were considered inoperable due to complex multiple pathologies including proliferative vitreoretinopathy (PVR) and poor prognoses of visual improvement. One eye underwent unsuccessful retinal detachment surgery. All three eyes had no light perception at final follow-up. In the reports of SPCIOL implantation where the outcome of retinal detachment was included,[8-11,14,15] the reattachment rate was 79% (23/29). PVR was reported as the cause of failure in almost all cases. In the previous series of SPCIOL with pars plana vitrectomy,[8] the two postoperative retinal detachments were successfully repaired although one had reduced BCVA. Also notable is a series of Marfan's syndrome patients, often considered to be at higher risk of retinal detachment, who underwent vitreolensectomy. Two of the 33 patients developed retinal detachment postoperatively and both of these were successfully repaired without visual loss.[16] Retinal detachment surgery following penetrating keratoplasty is known to have a much lower success rate. In one series,[17] retinal detachment repair was not attempted in 50% of cases. If undertaken, retinal reattachment was successful in 43–74%,[17–19] and of the successes less than half (41%) had visual acuity of 20/200 or better. It appears therefore that while the incidence of retinal detachment with and without pars plana vitrectomy may be similar, the outcomes provide a marked contrast. The poor outcome of subsequent retinal detachments suggest that, particularly in those eyes with penetrating keratoplasties, vitreoretinal assessment and involvement at an early stage in management is advisable.

This study confirmed that while a significant proportion of patients undergoing SPCIOL implantation may enjoy visual benefits, the likelihood of per- and postoperative complications, which has considerable impact on the long-term visual outcome, were substantial. Eyes in which SPCIOL implantations are indicated may have undergone considerable previous surgical and nonsurgical trauma. It is vital that the operating surgeon takes the potential complications of SPCIOL surgery into consideration when other less invasive methods of visual rehabilitation, for example, aphakic spectacles, contact lenses, may be effective in some patients. Alternatively, when these conservative methods fail, implantation of a modern flexible open loop ACIOL requires less surgical time and is probably less invasive than a suture fixation technique but is contraindicated by lack of adequate iris support, a shallow anterior chamber, borderline corneal compensation, and peripheral anterior synechiae, which are common in these eyes. Currently, there is no ideal solution to aphakic correction following complex anterior segment problems and the future may lie in extraocular techniques such as the new generation of extended wear silicone hydrogel lenses, if these become available in aphakic corrections, or corneal inlay surgery.

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