CLINICAL STUDY

Combined phacoemulsification–vitrectomy surgery: technique, indications and outcomes

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Abstract

Purpose and methods **Cataract extraction may be combined with vitrectomy to improve the operative view and/or enhance post-operative rehabilitation. A retrospective review of the records of all patients undergoing combined phacoemulsification and vitrectomy procedures since 1993 was performed. Surgical technique is discussed.**

Results **Fifty operations on 49 patients are described. Visual acuity improved overall (mean LogMAR acuity 1.58 ± 0.74 pre-operatively and 1.17 ± 0.76 LogMAR post-operatively), with 57% of patients having improved acuity post-operatively. Operative complications were few and post-operative complications were acceptable given the severity of the posterior segment disease.**

Conclusions **Combined phacoemulsification–vitrectomy surgery is a viable option in the management of posterior segment disease in the presence of cataract. It has a number of advantages over other approaches, and can be combined with intraocular lens insertion into the capsular bag in most cases.**

Key words Cataract, Intraocular lens (IOL), Phacoemulsification, Vitrectomy

Cataract surgery may be combined with vitrectomy to improve the operative view and/or enhance post-operative visual rehabilitation and subsequent treatment. The combined approach is likely to be cheaper and of less inconvenience to the patient than sequential surgery, and has been suggested to be safe and equally effective.[1]

Phacoemulsification (phaco) has superseded other methods of senile cataract extraction, yet lensectomy and large-incision extracapsular surgery are still used in conjunction with posterior segment procedures.[2] This may be because it is considered that peripheral capsular opacification would impair the view of the anterior retina, or because of capsular rupture and zonular weakness following trauma, although success in such cases has been reported.[3] Specialised posterior segment surgeons may also be less familiar with phaco technique. The potential advantages of phaco over alternative methods include retention of the lens capsule to facilitate intraocular lens (IOL) insertion, maintenance of a clear cornea and a watertight eye.[4,5]

Published data on this operation are limited. This paper presents results from a large series from a single centre.

Materials and methods

A retrospective review of all combined phaco–vitrectomy procedures under the care of a single vitreo-retinal unit since 1993 was performed. Cases were identified from operating theatre records. Visual acuities were recorded using Snellen letter charts; for graphical representation and statistical analysis they were converted to LogMAR format.[6,7] Visual acuities of counting fingers, hand movements, perception of light and no perception of light were awarded LogMAR scores of 1.9, 2.2, 2.5 and 2.8 respectively.[8] Pre- and post-operative visual acuities were compared using a *t*-test for paired data on the SPSS program.

Results

Operations on 53 eyes of 52 patients were identified; 3 were excluded due to inadequate records and 3 had inadequate visual acuity data. Only the first eye to be operated on from the bilateral patient is included in analysis of acuity data; thus acuity data are from 46 eyes of 46 patients. Visual acuity refers to best corrected acuity. All but one procedure was performed by the senior author (W.E.S.); the other was performed under his supervision. One combined extracapsular cataract extraction and vitrectomy was performed during the review period; it is not clear from the clinical notes why phaco was not attempted.

Twenty-six patients (53%) were male. The mean age was 59.5 ± 17.2 years. Follow-up

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Table 1. *Indications for surgery*

Indication	No. of eyes
Vitreous haemorrhage	
Diabetic	16
Non-diabetic	4
Retinal detachment	
Rhegmatogenous	2
Rhegmatogenous/tractional (PVR)	6
Traction (diabetic)	6
Epiretinal membrane	
Diabetic	5
Non-diabetic	6
Macular hole	5
Intraocular foreign body	1

averaged 9.5 months (range 1 week to 36 months). Excluding those with inadequate visual acuity data, the range was 2–36 months. Tertiary referrals with post-operative follow-up at the referring hospital account for the cases with very short follow-up times.

Twenty-five patients (51%) were diabetic, of whom 18 (72%) had type 2 disease. All cases had lens opacities that were sufficient to impair the operative view and/or were visually significant. No prophylactic removal of clear lenses was undertaken. The vitreo-retinal indications for surgery are listed in Table 1. The non-diabetic vitreous haemorrhages resulted from retinal vein occlusions in 3 cases (2 central, 1 branch) and from an eccentric subretinal neovascular membrane in 1 case. Six of the non-diabetic retinal detachments had proliferative vitreoretinopathy, 1 was a high myope with multiple holes and 1 was in an amblyopic eye.

Surgical techniques

All operations were performed under general anaesthesia. Phaco was performed first. In 48 (96%) a scleral tunnel was used, with a clear corneal incision in 2 cases. A slightly curved 6.5 mm partial-thickness incision was made with a diamond blade, then continued centrally with a 2.8 mm crescent knife. The anterior chamber was then entered with a 2.8 mm keratome to create a three-step watertight wound. A continuous circular capsulorrhexis was fashioned prior to 'divide and conquer' phaco and irrigation/aspiration of soft-lens matter. The scleral tunnel was sutured with a single 10–0 nylon suture before proceeding to vitrectomy. Viscoelastic was removed at this point, except with clear corneal sections, where viscoelastic was left in until vitrectomy was completed to help ensure maintenance of the anterior chamber.

A lens holder (Grieshaber) was sutured onto the limbus and three sclerostomies made 3.0 mm from the limbus. Three-port pars plana vitrectomy was performed. Intraocular tamponade was used in 15 cases: 10 gas (20%) and 5 silicone oil (10%). Fourteen of 24 (50%) diabetics had endolaser panretinal photocoagulation. Twenty-three of 50 (46%) cases required peeling of retinal membranes.

Table 2. *Reasons for non-insertion of an intraocular lens*

Reason	No. of eyes
Retinal detachment recurrence likely	5
Uveitis in only eye	1
Aggressive PDR (poor macular prognosis)	1
High myopia	1
Not stated	2

PDR, proliferative diabetic retinopathy.

Large (6 mm) optic polymethylmethacrylate (PMMA) lenses (Storz 68UV) were used in 35 cases (70%). Foldable hydrogel lenses (Storz Hydroview) were used in 5 cases (10%). No IOL was inserted in 10 cases, for reasons listed in Table 2. In 5 of these the decision not to implant was made pre-operatively, and in 5 it was made per-operatively. In 3 of the 5 retinal detachment cases a sulcus-fixated PMMA IOL was implanted as a secondary procedure once it was felt that the retina was flat and safe (3–4 months later).

Where an IOL was used it was inserted after the completion of the posterior segment procedure but before tamponade, where used. The IOL was placed in the capsular bag in all but in 1 case, described below. PMMA lenses were inserted through the scleral tunnel enlarged to 6.5 mm; hydrogel lenses through the scleral tunnel or corneal wound enlarged to approximately 3.8 mm.

Operative complications

Operative complications were few and minor. The capsulorrhexis extended peripherally in 1 case; phaco was completed uneventfully and a PMMA IOL placed in the sulcus. One scleral-approach phaco was converted to a clear corneal approach because of difficulty in entering a shallow anterior chamber.

Post-operative complications

Post-operative complications are listed in Table 3, separated into those of early (1 month or less post-operatively) and late onset (more than 1 month post-operatively). The majority were minor and transient. Three patients had persistently raised intraocular

Table 3. *Post-operative complications and their timing*

Complication	Early onset[a]	Late onset[b]
Increased IOP	4	3
Uveitis	6	0
Capsular opacity	2	7
Vitreous haemorrhage	4	3
Retinal detachment	1	4
Other		
Shallow AC	1	0
Choroidal haemorrhage	1	0
Hyphaema	1	0
Corneal toxicity	1	0
Macular hole	1	0

IOP, intraocular pressure; AC, anterior chamber.
[a]One month or less post-operatively.
[b]More than 1 month post-operatively.

pressure (2 rubeotic and 1 ghost cell glaucoma). Nine (18%) developed posterior capsule opacification requiring Nd:YAG capsulotomy. Four early vitreous haemorrhages occurred, 2 in diabetics; and 3 late vitreous haemorrhages, all in diabetics. One eye, in a diabetic patient treated for macular hole who had a PMMA IOL inserted, developed severe uveitis, resulting in pupil occlusion by a fibrinous plaque.

No IOL-related complications were noted in the 5 patients who received a folding IOL. One diabetic patient with a PMMA lens developed fibrinous uveitis, leading to occlusio pupillae. Nd:YAG peripheral iridectomies were successful in relieving the pupil block, and the fibrin cleared with intensive topical steroid treatment. No instances of IOL capture or clinically significant IOL decentration were noted.

Visual outcome

Pre- and post-operative visual acuities at 1 month and final follow-up are displayed in Fig. 1. In LogMAR notation a score a 0.0 equates to Snellen 6/6, and 1.0 equates to 6/60. Each increase of 0.3 LogMAR equates to a halving of visual acuity.[6] Overall mean acuity improved significantly from 1.58 ± 0.74 LogMAR pre-operatively to 1.29 ± 0.72 LogMAR at 1 month and 1.17 ± 0.76 LogMAR at final follow-up ($p = 0.029$ and 0.001, respectively).

Twenty-six eyes (57%) had improved acuity at final follow-up, in 10 (22%) the acuity was unchanged and 10 (22%) it deteriorated.

Separating eyes by indication for surgery showed that all groups improved significantly except for the 8 eyes with non-diabetic retinal detachments, 7 of which had complex detachments while the remaining eye was amblyopic. In these cases the mean pre-operative acuity was 1.89 ± 0.71 LogMAR, and 1.82 ± 0.53 LogMAR at final follow-up ($p = 0.88$).

Discussion

There are three main issues that need to be addressed when dealing with a patient with combined cataract and vitreo-retinal disease. The first is whether to perform combined or sequential surgery; the second is which technique of cataract extraction to use; and the third, whether or not to implant an IOL. This paper suffers from the limitations of a retrospective review of patients' notes in that data collection was incomplete in 7 of 53 eyes identified (13%). It is also likely that pre- and post-operative complications are under-reported in such a study. Despite its limitations, the data collected do help to address these issues.

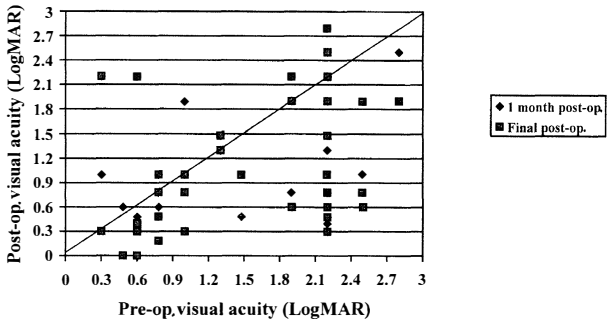

Fig. 1. *Visual acuity, before and after surgery. The diagonal line represents 'no change', with cases below the line having improved vision post-operatively. Where the acuity was unchanged from 1 month to final follow-up, it appears as final acuity only.*

The potential benefits of combined surgery have already been described; disadvantages might include increased technical difficulty and an increased rate of complications. There is no published randomised study comparing combined and sequential surgery. Senn *et al.*,[1] reporting two consecutive non-randomised series, found that there was an increased incidence of fibrinous uveitis in their combined group compared with their sequential group. However, of their 6 cases with this complication 4 had a prior history of uveitis; 1 was diabetic, as was our 1 patient with fibrinous uveitis. No uveitis persisted beyond 1 month in our series. Previous reports on smaller numbers of patients support the impression that the combined technique is safe.[3–5,9,10]

Honjo and Ogura[11] published a series of 76 combined phacoemulsification–vitrectomy procedures with IOL insertion in 76 eyes of 54 patients. The IOLs used were acrylic foldable (57%), silicone foldable (27%) and rigid PMMA (16%). The results were similar to those in our series, although IOL-related complications were more common. Posterior capsulotomy was needed in 17% of cases compared with 18% in our series. Posterior synechiae between iris and IOL were noted in 15% of their cases, the high rate possibly being due to the fact that all their patients were diabetic.

Hydrogel folding lenses have been used successfully in this centre, although we have now reverted to rigid PMMA lenses. This is because the rigid lens is less inclined to be displaced forwards by posterior tamponade and thus to cause shallowing of the anterior chamber. We do not use silicone lenses because of concerns regarding silicone oil adhesion to the lens should tamponade with this agent subsequently become necessary.[12]

The timing of IOL insertion is important. Where panretinal photocoagulation is required, this should be completed before IOL insertion to avoid the edge of the IOL obscuring the anterior retina.

The visual acuity results reported reflect the severity of the posterior segment disease in this cohort of patients. Of the 10 (22%) cases where acuity deteriorated post-operatively, 9 were due to progression or recurrence of pre-existing disease, and 1 due to a complication of surgery (macular hole formation). There was no control group to demonstrate the natural history of the disease amongst these patients; however, it can reasonably be assumed that conditions such as proliferative diabetic retinopathy and proliferative vitreo-retinopathy would have progressed without treatment. In such cases, arresting the disease process to preserve a viable eye can be considered a surgical success. In other cases, where

macular function is irreversibly compromised, restoration of visual field may be a valuable gain.

Cataract surgery in diabetics carries a higher risk of intraoperative and post-operative complications.[13] It does not itself, however, lead to progression of retinopathy,[14] and facilitates treatment where lens opacity obscures the retinal view.

The increasing acceptance of small-incision phacoemulsification (phaco) as the procedure of choice for senile cataract extraction has led to its introduction in combined surgery. Large-incision extracapsular (ECCE) and lensectomy techniques have previously been described for use in combined surgery.[15–17] There is no published direct comparison with phaco, but there are strong reasons to suggest that phaco is the superior technique. Lensectomy with preservation of the anterior capsule allows for insertion of a sulcus-fixated IOL, but involves per-operative incision of the posterior capsule, increasing the risk of rubeosis in diabetics.[18] It also requires the use of a fragmatome for harder lenses, with an increased risk of retinal detachment.[19,20] The presence of an IOL in the sulcus may cause iris chafing with breakdown of the blood–iris barrier and exacerbation of uveitis. For this reason 'in-the-bag' placement of the IOL has been advocated in uveitics.[21,22]

ECCE preserves the posterior capsule, but at the expense of reduced corneal clarity and a softer eye relative to small-incision surgery.[2] Suture-induced astigmatism is also likely to be higher.

Loss of the red reflex may make capsulorrhexis, and thus phaco, difficult in eyes with vitreo-retinal pathology, although phaco was successfully completed in all cases in this series. Approaches to capsulorrhexis in cases with a poor red reflex are well described.[23] That only 1 ECCE–vitrectomy was performed in the study period would suggest that this success was not achieved by selecting out those eyes in which phaco was likely to be difficult. A randomised trial would be needed, however, to exclude such selection bias definitively.

The authors prefer a scleral approach to phaco in combined vitrectomy surgery. This results in minimum corneal disturbance and a watertight wound that is unaffected by the limbus-sutured vitrectomy lens holder. Its major advantage, however, is evident when implanting the IOL. Because the IOL enters the eye just anterior to the iris plane it is almost flat as it is inserted. The scleral wound is therefore opened less by lens insertion than a similar corneal wound would be, resulting in less shallowing of the anterior chamber. During IOL insertion the posterior infusion is stopped, and the anterior chamber maintained with viscoelastic. The viscoelastic is removed again once the IOL in place. In cases where a posterior capsulorrhexis has been performed the posterior infusion is continued to maintain the globe during IOL insertion, but at a low flow rate to minimise the risk of iris prolapse.

The authors recommend insertion of the IOL prior to intraocular tamponade to reduce the risk of anterior chamber shallowing.

The issue of IOL use in cases with vitreo-retinal pathology is contentious. In his editorial in 1986, Tasman[24] listed untreated proliferative retinopathy, chronic or recurrent uveitis, severe posterior segment trauma, Stickler's syndrome and giant retinal breaks as contraindications to insertion of an IOL. As confidence with IOLs has grown, particularly with the introduction of continuous circular capsulorrhexis such that 'in the bag' placement of the IOL is assured, so this list has diminished. Recent literature describes implantation of IOLs in diabetics with proliferative disease,[1,4,9–11,15–17] uveitic patients,[1,5,15] and following posterior segment trauma.[3–5,9,15] In this series IOL insertion was withheld primarily in cases of retinal detachment with pre-existing proliferative vitreo-retinopathy or multiple holes. In these cases the risk of needing further surgery was high, and the presence of an IOL might have impaired the view of the peripheral retina. IOL implantation was therefore deferred until the retina was considered secure. IOLs were successfully implanted in all but 1 of the 24 diabetic eyes.

Conclusions

Combined phacoemulsification–vitrectomy surgery is a viable option in the management of posterior segment disease in the presence of cataract. It has a number of advantages over other approaches, and can be combined with IOL insertion into the capsular bag in most cases. In cases of complicated retinal detachment it may be prudent to delay IOL implantation until reattachment has been achieved.

References

1. Senn P, Schipper I, Perren B. Combined pars plana vitrectomy, phacoemulsification, and intraocular lens implantation in the capsular bag: a comparison to vitrectomy and subsequent cataract surgery as a two-step procedure. Ophthalmic Surg Lasers 1995;26:420–8.
2. Ryan EH, Gilbert HD. Lensectomy, vitrectomy indications and techniques in cataract surgery. Curr Opin Ophthalmol 1996;7:69–74.
3. Lam DSC, Tham CCY, Kwok AKH, Gopal L. Combined phacoemulsification, pars plana vitrectomy, removal of intraocular foreign body (IOFB), and primary intraocular lens implantation for patients with IOFB and traumatic cataract. Eye 1998;12:395–8.
4. Mamalis N, Teske MP, Kreisler KR, Zimmerman PL, Crandall AS, Olsen RJ. Phacoemulsification combined with pars plana vitrectomy. Ophthalmic Surg 1991;22:194–8.
5. Koenig SB, Mieler WM, Han DP, Abrams GW. Combined phacoemulsification, pars plana vitrectomy, and posterior chamber intraocular lens insertion. Arch Ophthalmol 1992;110:1101–4.
6. Bailey IL, Lovie JE. New design principles for visual acuity letter charts. Am J Optom Physiol Optics 1976;53:740–5.
7. Moseley JM. Graphical representation of visual acuity data. Ophthalmic Physiol Opt 1997;17:441–2.
8. Javitt JC, Brenner MH, Curbow B, Legro MW, Street DA. Outcomes of cataract surgery: improvements in visual acuity and subjective visual function after surgery in the first, second and both eyes. Arch Ophthalmol 1993;111:686–91.

9. McElvanney AM, Talbot EM. Posterior chamber lens implantation combined with pars plana vitrectomy. J Cataract Refract Surg 1997;23:106–9.
10. Hurley C, Barry P. Combined endocapsular phacoemulsification, pars plana vitrectomy, and intraocular lens implantation. J Cataract Refract Surg 1996;22:462–6.
11. Honjo M, Ogura Y. Surgical results of pars plana vitrectomy combined with phacoemulsification and intraocular lens implantation for complications of proliferative diabetic retinopathy. Ophthalmic Surg Lasers 1998;29:99–105.
12. Apple DJ, Federman JL, Krolicki TJ, Sims JCR, Kent DG, Hamburger HA, *et al*. Irreversible silicone oil adhesion to silicone intraocular lenses: a clinicopathologic analysis. Ophthalmology 1996;103:1555–62.
13. Minckler D, Astorino A, Hamilton P. Cataract surgery in diabetics. Ophthalmology 1988;105:949–50.
14. Wagner T, Knaflic D, Rauber M, Mester U. Influence of cataract surgery on the diabetic eye: a prospective study. Ger J Ophthalmol 1996;103:1555–61.
15. Benson WE, Brown GC, Tasman W, McNamara JA. Extracapsular cataract extraction, posterior chamber lens insertion, and pars plana vitrectomy in one operation. Ophthalmology 1990;97:918–21.
16. Kokame GT, Flynn HW, Blankenship GW. Posterior chamber intraocular lens implantation during diabetic pars plana vitrectomy. Ophthalmology 1989;96:603–10.
17. Menchini U, Azzolini C, Camesasca FI, Brancato R. Combined vitrectomy, cataract extraction, and posterior chamber intraocular lens implantation in diabetic patients. Ophthalmic Surg 1992;22:69–73.
18. Rice TA, Michels RG, Maguire MG, Rice EF. The effect of lensectomy on the incidence of iris neovascularisation and neovascular glaucoma after vitrectomy for diabetic retinopathy. Am J Ophthalmol 1983;95:1–11.
19. Fastenberg DM, Schwartz PL, Shakin JL, Golub BM. Management of dislocated nuclear fragments after phacoemulsification. Am J Ophthalmol 1991;112:535–9.
20. Borne MJ, Tasman W, *et al*. Outcomes of vitrectomy for retained lens fragments. Ophthalmology 1996;103:971–6.
21. Michelson JB, Friedlander MH, Nozik RA. Lens implant surgery in pars planitis. Ophthalmology 1990;97:1023–6.
22. Foster RE, Lowder CY, Meisler DM, Zakov N. Extracapsular cataract extraction and posterior chamber intraocular lens implantation in uveitis patients. Ophthalmology 1992;99:1234–41.
23. Vasavada A, Singh R, Desai J. Phacoemulsification of white mature cataracts. J Cataract Refract Surg 1998;24:270–7.
24. Tasman W. Are there any retinal contraindications to cataract extraction and posterior chamber implants? Arch Ophthalmol 1986;104:1767–8.