CLINICAL STUDY

Combined phacoemulsification, pars plana vitrectomy, removal of intraocular foreign body (IOFB), and primary intraocular lens implantation for patients with IOFB and traumatic cataract

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Abstract

Purpose and methods **Small-incision cataract extraction by phacoemulsification through an anterior continuous circular capsulorhexis, pars plana vitrectomy, forceps removal of intraocular foreign body (IOFB) and primary intraocular lens implantation were performed in 4 eyes (4 patients) with IOFB and traumatic cataract, as an emergency combined procedure.**
Results **At a mean follow-up of 12.3 months (range 7–19 months) the best corrected visual acuity of the 4 eyes ranged from 6/6 to 6/12. The only complication encountered in our series was an opacified posterior capsule that developed 10 months post-operatively in one case. This was easily dealt with by neodymium:YAG laser capsulotomy, with good final visual outcome.**
Conclusions **The results of combined one-stage instead of sequential surgeries, and phacoemulsification instead of lensectomy or extracapsular cataract extraction for patients with IOFB and cataract are encouraging. It could be a good option in selected cases. However, the safety and efficacy of this combined procedure need to be evaluated further by a larger-scale, longer follow-up study.**

Key words Cataract, Continuous circular capsulorhexis (CCC), Intraocular foreign body (IOFB), Intraocular lens (IOL), Phacoemulsification

Intraocular foreign body (IOFB) resulting from penetrating ocular injury is often associated with traumatic cataract. Cataract extraction under such circumstances is often necessary to allow clear visualisation of the posterior segment, and has traditionally been done by lensectomy.[1–4] Extracapsular cataract extraction (ECCE) with a 'can-opener' capsulotomy[1,2,4] is an alternative. Phacoemulsification with an anterior continuous circular capsulorhexis (CCC) offers many advantages over lensectomy or ECCE.[5,6] This newer method of cataract extraction has become increasingly popular for simple senile cataract. However, little information is available regarding the application of phacoemulsification to the extraction of cataract in patients with IOFB and traumatic cataract.

Amongst patients with IOFB and traumatic cataract, visual rehabilitation following their cataract extraction and removal of the IOFB poses a unique challenge to ophthalmic surgeons. Such patients are typically young males working in dusty environments, where contact lenses are not usually well tolerated. As traumatic injury is often unilateral, aphakic glasses are unsuitable. An intraocular lens (IOL) offers good unaided visual acuity and provides useful binocular function to this group of patients, and is thus preferred.

Primary IOL implantation, as opposed to secondary implantation, has the benefit of allowing earlier visual rehabilitation, which is particularly important to this group of young working patients who have to shoulder financial and social responsibilities.

This retrospective review studied the visual outcome and the intra- and post-operative complications in four consecutive patients with IOFB and significant traumatic cataract who had received combined phacoemulsification, pars plana vitrectomy (PPV), removal of IOFB and primary IOL implantation.

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Materials and methods

This retrospective study evaluated a series of four consecutive patients who presented to us with penetrating eye injuries resulting in IOFB and traumatic cataract between March 1996 and March 1997. All were managed by phacoemulsification with anterior CCC, PPV, forceps removal of IOFB and primary IOL implantation, in a combined one-stage procedure.

Pre-operatively, all patients had a thorough physical and eye examination. Localisation of the IOFB in each of the patients was achieved by a computed tomography (CT) scan of the globe. All patients had emergency keratometry (K) and axial length (A) measurements taken before their operations. IOL power was calculated using the SRK II formula prior to surgery.

Surgical techniques

All surgeries were performed by one of us (D.S.L.). Patient 2 received local anaesthesia while the other three patients had general anaesthesia. Although linear and singular corneal laceration was present in each patient, only patient 4 required a primary repair of the corneal laceration before proceeding to other procedures. The corneal wounds in the other three cases were self-sealing and the anterior chambers were well formed and maintained. The anterior and posterior lens capsules were ruptured in all cases. The procedures performed for these patients included small (5 mm) self-sealing three-plane scleral tunnel wound construction, anterior CCC, phacoemulsification, PPV, removal of IOFB and primary IOL implantation. Viscoelastic substance was used freely to facilitate the procedures and minimise intraocular tissue damage.

Anterior CCC was achieved in all cases. While in two cases the sites of anterior capsular rupture lay centrally and well within the anterior CCC, one patient had the anterior capsular rupture located peripheral to the CCC (Table 1). The remaining patient had a large (~3 mm long) and radially orientated anterior capsular rupture that was directly in the way of the planned CCC. The CCC was started by making a small cut at the rupture site in a concentric manner with a pair of Vannas scissors. The cut edge was then grasped with a pair of capsulorhexis forceps and the CCC completed with the standard tearing technique. A large quantity of viscoelastic agent was used to fill the anterior chamber while the anterior CCC was being made.

Phacoemulsification was then performed using a bimanual technique. As the nucleus was fairly soft in these relatively young patients, only suction aspiration alone or very low phaco power (phacoaspiration) was required. The infusion rate was set at a low level to minimise the chances of enlarging the pre-existing posterior capsular tear. Manual aspiration of the remaining cortical matter was performed with a Simcoe infusion/aspiration (I/A) cannula before the scleral wound was closed with a 10–0 nylon suture.

This was followed by a standard three-port PPV. Intraoperative 360° scleral indentation was performed in all cases to facilitate removal of inflammatory debris and IOFB identification. The IOFBs identified were then removed by IOFB forceps under direct visual guidance.

Cryotherapy and endolaser were employed as required to secure the retina. In patient 1, cryotherapy was applied to the retinal areas immediately adjacent to the IOFB. In patients 2 and 3, neither cryotherapy nor endolaser was needed, as there was no significant retinal damage or lesion. In patient 4, argon endolaser was applied to two retinal breaks identified after closed vitrectomy was done.

The IOL was implanted after all vitreoretinal procedures had been completed. Optical distortion of the vitreoretinal view by the IOL was thus avoided. All patients received a one-piece biconvex polymethylmethacrylate heparin-surface-modified IOL. The optic diameters of the IOLs used for capsular and sulcus implantations were 5.0 mm and 6.5 mm respectively.

Aqueous and vitreous specimens, and swabs of the IOFB, were sent for microbiological evaluation in each case. Post-operatively, patients were given topical homatropine 4% twice daily, chloramphenicol and dexamethasone 0.1% four times daily. Patients were discharged between 2 and 5 days after surgery. Complete ocular examinations including the assessment of vitreoretinal conditions, IOL position, refractive status and best corrected visual acuity (BCVA), was carried out at subsequent follow-up examinations.

Results

All patients were male subjects who sustained penetrating injury to one eye by high-velocity metallic fragments whilst at work on construction sites. The mean age was 40 years (range 35–45 years). The first three patients had one IOFB found, while the fourth patient had two IOFBs. Pre-operative visual acuity ranged from hand movement to 6/36 (Table 1).

Table 1. *Demographics and results*

Patient no.	Sex/Age (yr)	Pre-operative visual acuity	Location of anterior capsular rupture	IOL placement	Post-operative refraction	Post-operative BCVA	Follow-up (months)	Complications
1	M/41	CF	Para-central	Capsular	−3.25DS−1.25DC×138°	6/9	19	PCO
2	M/45	6/36	Para-central	Sulcus	−0.50DS−2.00DC×45°	6/6	12	Nil
3	M/40	CF	Peripheral	Sulcus	−2.75DS	6/12	11	Nil
4	M/35	HM	Mid-peripheral	Sulcus	−3.00DS−1.00DC×150°	6/12	7	Nil

IOL, intraocular lens; BCVA, best corrected visual acuity; PCO, posterior capsular opacification; CF, counting fingers; HM, hand movements.

All four patients were operated on within 24 h of presenting to us. However, the mean time interval between injury and operation was 37 h (range 6–72 h). IOL implantation was capsular in the first case but in the sulcus in the other three cases due to uncertainty of the adequacy of support from the partially torn posterior capsules. The duration of the combined operation ranged from 105 to 175 min (mean 137.5 min).

At subsequent follow-ups, patients 1 and 2 had a BCVA of 6/9 and 6/6 in the injured eye respectively. Patients 3 and 4 both achieved a BCVA of 6/12. All four operated eyes suffered a myopic shift in their final spherical refraction, which ranged from −0.50 D to −3.25 D (mean 2.38 D). The final cylindrical refractive error of the four eyes ranged from 0.00 D to +2.00 D (mean +1.06 D). The fellow eyes of all four patients were planar and had 6/6 vision before and after the surgery.

The four patients were followed up for a mean of 12.3 months (range 7–19 months). During the follow-up period patient 1 developed moderate posterior capsular opacification by 10 months post-operatively. The BCVA dropped from 6/9 to 6/24. This was corrected back to 6/9 with a Nd:YAG laser capsulotomy. At the time of writing, no other post-operative complications have been encountered. All patients have returned to a normal working life.

Discussion

IOFB resulting from penetrating ocular injury is often associated with traumatic cataract. In selected cases the IOFB can be removed using a lens-sparing procedure, if the traumatic cataract is localised and does not involve the visual axis.[7] Otherwise, the cataract is usually generalised, and its removal is required either before or after posterior segment surgeries. This can be done as part of a combined one-stage procedure or as separate procedures. Combined anterior and posterior segment surgeries as opposed to sequential operations has, in selected cases, the benefits of reducing the cost, risk from anaesthesia, total amount of eye trauma and inconvenience. Early visual rehabilitation is another major advantage, especially in IOFB patients, who are usually young working people. These are probably the reasons why combined surgery has been advocated recently.[1–3]

In the combined procedure, the mode of cataract surgery is important. Should it be lensectomy, ECCE or phacoemulsification? Phacoemulsification performed through an anterior CCC[5] has been gaining popularity among eye surgeons for simple senile cataract extraction. However, traumatic cataract in patients with IOFB is far more complicated and has traditionally been removed by means of lensectomy, via either the anterior[1,4] or the pars plana approach.[1–4] If the whole lens together with its capsules is removed an anterior chamber or scleral-fixated IOL would be needed. Alternatively, the anterior capsular rim could be left behind[8] to support a sulcus-placed IOL. However, this may not always be possible when the damage to the anterior capsule or zonules is substantial. Advantages[9] of phacoemulsification over lensectomy include faster nucleus removal, less frequent dislocation of nuclear fragments into the vitreous, easier removal of peripheral lens cortical material, and the possibility of capsular IOL fixation as shown in patient 1 of this series.

ECCE with a 'can-opener' capsulotomy[1,2,4] is a widely accepted alternative to lensectomy. With ECCE, the large corneoscleral incision may leak when the intraocular pressure is elevated during the subsequent vitrectomy surgery.[8] Moreover, corneal oedema may be more likely as a result of the longer duration of manipulation and fluid irrigation in the anterior segment. This may interfere with visualisation of the retina during the subsequent vitreoretinal procedures. Furthermore, the can-opener anterior capsulotomy in ECCE may not be able to give adequate support to the posterior chamber IOL when there is significant posterior capsular tear.

Modern phacoemulsification technique offers many advantages over conventional ECCE. Firstly, the small three-plane self-sealing scleral tunnel wound construction helps to maximise the integrity of the eyeball and to facilitate subsequent vitreo-retinal procedures. Secondly, suction aspiration alone is usually sufficient for removal of the cataract, as traumatic cataracts in young patients are often softer in consistency. Phaco power and usage can be kept to a minimum to limit damage to intraocular tissues, especially the corneal endothelium. Low ultrasound energy, coupled with low flow of fluid, help to reduce the risk of enlarging the posterior capsular tear. Additionally, we used manual infusion and aspiration as it allows a finer control of the removal and cleansing of the residual cortical matter.

Furthermore, when the posterior capsular rupture is not too large, it can be converted into a primary posterior CCC. Primary posterior CCC has been used in a number of settings, including simple senile cataract, paediatric cataract and uveitic cataract,[10,11] to prevent posterior capsular opacification and the need for Nd:YAG laser capsulotomy. With a converted posterior CCC the risk of tear extension or enlargement would be much reduced. If, despite all these measures, the posterior capsular tear did become enlarged and some lens fragments dropped into the posterior segment, the fragments could effectively be dealt with during the subsequent process of closed vitrectomy. Thirdly, the anterior CCC employed as part of the modern phacoemulsification technique, as opposed to the conventional 'can-opener' capsulotomy in ECCE,[5,6] enables the integrity and strength of the anterior capsular rim to be maximally preserved. The risk of further zonular or capsular tear under mechanical stress in an intact anterior CCC is lower. This is crucial to the stability and centration of the IOL placement, regardless of whether sulcus or capsular fixation is being used. The successful creation of a good anterior CCC is vital to the overall success of the combined procedure. For instance, in the situation of a large posterior capsular tear, the presence of an intact anterior CCC will usually allow safe implantation of the sulcus-fixated IOL.

In our series we encountered traumatic ruptures at different locations of the anterior capsule. The different locations demand different approaches in the creation of the CCC. Central and very peripheral ruptures pose the least difficulty, as the rupture site is not in the path of the CCC. On the other hand, when the rupture is large and located in the mid-periphery of the anterior capsule it may interfere with the creation of the CCC. Our approach to this problem is to start with a small cut made at the tear in a concentric manner and then to complete the CCC with a pair of capsulorhexis forceps, as demonstrated in patient 4 of this study. A small radial tear with or without peripheral extension may be the result. Although it is still quite possible to achieve stable IOL fixation at the sulcus on the basis of the residual anterior and posterior capsular remnants, this should best be avoided, especially when the technique has not been adequately mastered. The selection of suitable cases for this combined procedure is important, and we would recommend selecting cases that have either a central or a peripheral anterior capsular rupture.

In all three patients with a sulcus-fixated IOL, the anterior capsule rim provided adequate support for the IOL throughout the follow-up period. There have been no instances of decentration or tilting of the IOL. The visual axis through the anterior capsule remained clear during the follow-up period, with no formation of Elschnig's pearls or fibrosis obscuring the visual axis.

Although successful use of phacoemulsification as part of the combined surgery for various vitreo-retinal conditions with concomitant cataract has been reported,[12,13] phacoemulsification through an anterior CCC has been scarcely applied, as part of a combined procedure, to penetrating ocular injuries with IOFB and traumatic cataracts.[1-3,13] To our knowledge, the largest series of traumatic eye injuries managed by combined cataract extraction, posterior segment surgery and primary IOL implantation was the 16 cases reported by Soheilian *et al.* in 1995.[1] Ten of 16 cataracts were extracted by lensectomy (7 cases via an anterior approach and 3 by the pars plana route), and the remaining 6 by ECCE. Neither phacoemulsification nor anterior CCC was employed in that series. In another series reported by Rubsamen *et al.* in 1995,[2] only 1 of 14 cataracts was removed by phacoemulsification. Koenig *et al.*[14] reported two traumatised eyes, one with an IOFB and the other with a retinal detachment, both of which were managed by combined phacoemulsification and PPV but without primary IOL implantation. The phacoemulsification was performed through a 'can-opener' capsulotomy rather than a CCC as in our series.

The results from our small series are encouraging. Despite the fact that patients 3 and 4 had some para-axial corneal scar, all had a BCVA of 6/12 or better at the latest follow-up. The smaller wound in phacoemulsification produces less post-operative astigmatism. The mean astigmatism in the four cases of this series is +1.06 D (range 0.00 to +2.00 D). Pre-operative A+K for IOL power calculation were done in all eyes in this series. The mean post-operative spherical refraction was −2.38 D (range −0.50 to −3.25 D). The injured eye may introduce errors in the A+K measurements. The accuracy of IOL power estimation may be improved by taking into consideration the A+K readings of the non-injured eyes, as these patients are usually isometropic. Last but not least, primary IOL implantation should best be avoided in situations where major vitreoretinal surgery is highly likely to follow, as in very severe eye injury.[13]

In conclusion, our series of four patients serves to demonstrate that phacoemulsification with anterior CCC may be a viable and better alternative to lensectomy or ECCE in the extraction of traumatic cataract in selected cases of penetrating ocular injury with IOFB. However, the safety and efficacy of this combined procedure have to be further evaluated by a larger-scale and longer follow-up study.

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