Eye (2015) 29, 1495–1503

www.nature.com/eye

CLINICAL STUDY

Outcomes of combined phacoemulsification and deep sclerectomy: a 10-year UK single-centre study

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Abstract

Purpose **To report the outcomes of combined phacoemulsification and -deep sclerectomy (phaco-DS) from a single UK centre over a 10-year period.**

Methods **Retrospective analysis of phaco-DS data extracted from an ongoing glaucoma surgery database within Calderdale and Huddersfield NHS Trust. Two hundred and ninety-six eyes of 282 patients were included. Data included patient demographics, pre- and postoperative intraocular pressure (IOP), use of mitomycin C (MMC), spacer device implantation, and follow-up details including surgical success rates. IOP success criteria were: (A) IOP <19 mm Hg and/or 20% decrease from baseline and (B) IOP <16 mm Hg and/or 30% drop from baseline.**

Results **Mean follow-up was 63.5 ± 35.3 months. MMC was applied in 145 eyes (49%). Kaplan–Meier success rates in all eyes for criteria A were 89.1% and 80% with glaucoma medications (qualified success) and 81.2% and 68.3% without medications (unqualified success) at 2 and 5 years, respectively. Qualified success for criteria B was 72.4 and 61.4% and unqualified rates were 67.2 and 55.2% for the same time periods. Repeated-measures ANOVA showed significantly lower IOP in the phaco-DS with MMC group up to 3 years postoperatively ($P = 0.002$). Cox's proportional hazards for criteria B, however, showed no significant effect of MMC application in the long term ($P = 0.2$). Increasing age and laser goniopuncture were positively associated with success, whereas the absence of spacer devices was negatively associated. At last follow-up, 20% of eyes were on glaucoma medications. Complication rates were low with hypotony rates of 0.68%.**

Conclusions **This study confirms the long-term safety and efficacy of phaco-DS as a primary glaucoma procedure.**

Eye (2015) **29,** 1495–1503; doi:10.1038/eye.2015.163; published online 4 September 2015

Introduction

Non-penetrating glaucoma surgery (NPGS) such as viscocanalostomy and deep sclerectomy (DS) were introduced in the 1990s as safer alternatives to trabeculectomy.[1,2] The essential difference between NPGS and trabeculectomy is that the procedure entails the creation of a filtration membrane, the trabeculo-Descemet's membrane, rather than a sclerostomy, with excision of the inner scleral flap creating a subscleral lake. Different outflow pathways have been proposed for NPGS including increased aqueous flow through Schlemm's canal, collection into an 'intrascleral bleb', suprachoroidal drainage, and subconjunctival flow with bleb formation.[3–9] Papers using modern technology such as ultrasound biomicroscopy and optical coherence tomography have now clearly demonstrated the presence of an 'intrascleral 'bleb' and 'subconjunctival flow'.[10,11]

IOP lowering with DS and postoperative laser goniopuncture (LGP) has been shown to be comparable to trabeculectomy with a lower incidence of complications in the immediate postoperative period according to some reports.[12–15] In the presence of significant cataract with glaucoma, combined phacoemulsification with trabeculectomy is commonly performed.[16] Phacoemulsification combined with DS (phaco-DS) has been shown to be as effective as phacoemulsification with trabeculectomy (phaco-trab) in lowering IOP.[14,17] In this large case series, we seek to report the outcomes of phaco-DS from a single UK centre over a 10-year period. To our knowledge, this is the largest cohort to describe this procedure with such long-term follow-up results.

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Received: 26 March 2015
Accepted in revised form: 27 July 2015
Published online: 4 September 2015

The results of this study were presented at the UKEGS congress in Bristol, UK, November 2014.

Materials and methods

This study is a retrospective, comparative, non-randomised case series. Consecutive patients undergoing phaco-DS between August 2001 and March 2008 were identified from a correlational ongoing glaucoma surgery database (Microsoft Access 2010, Microsoft Corporation, Redmond, WA, USA). Data entry was completed at the time of surgery and contemporaneously at each postoperative visit. Three hundred and seventy-three eyes of 326 patients undergoing surgery were identified and 296 eyes of 282 patients were included in the study. Eyes with previous conjunctival or glaucoma surgery were excluded as were patients with a history of uveitis in either eye. Patients with <12 months follow-up were also excluded as were the fellow eyes of people undergoing eventual bilateral surgery. In the latter however, if one eye had antimetabolite enhancement and the other none, both eyes were included for analysis. The excluded eyes consisted of 32 fellow eyes, 23 eyes with follow-up <12 months, 15 eyes with prior trabeculectomy, one eye with previous DS, four uveitic eyes, one eye with ocular pemphigoid, and one with previous multiple Lucentis injections.

Data extracted from the database included patient demographics, Snellen visual acuity (VA), pre- and postoperative intraocular pressure (IOP), use of mitomycin C (MMC), spacer device implantation, postoperative complications, subsequent procedures including reoperation for glaucoma, and the use of supplemental medical therapy.

All procedures were performed or supervised closely by one consultant glaucoma surgeon (NA) using a standardised technique as described previously,[18] with a few subsequent modifications that are detailed below. In brief, a standard DS was followed by a temporal clear corneal phacoemulsification. A 6-0 vicryl traction suture was used to infraduct the globe and a fornix-based conjunctival flap was fashioned. MMC was applied at a dose of 0.2 mg/ml for 2 min on four PVA sponge fragments placed under the conjunctival flap. A limbal-based $5 \times 4\,mm^2$ superficial scleral flap was created to ~1/3 scleral depth and reflected 1 mm into the clear cornea. Within the bed of the superficial flap, a 90% depth scleral flap was fashioned and the ends of Schlemm's canal cut. Dissection of the deep scleral flap was continued into clear cornea to expose a trabeculodescemetic membrane (TDM) of around 3–4 mm width. Juxtacanalicular trabecular meshwork was peeled using blunt-tipped capsulorhexis forceps. The deep scleral flap was then excised. Cases performed over the latter years involved a linear full-thickness scleral incision at the apex of the scleral lake and implantation of an HEMA spacer device (Esnoper V-2000; AJL Ophthalmics, Álava, Spain) into the suprachoroidal space, which was then anchored with one nylon 10-0 suture. Earlier cases involved the use of different spacer devices or viscoelastic to aid maintenance of the intrascleral lake (details are provided in Tables 1a and b).

The outer scleral flap and conjunctiva were then closed with nylon 10-0 interrupted sutures. If a microperforation occurred without iris prolapse, the procedure was continued as described above. If a macroperforation occurred, then a peripheral iridectomy was made in the presenting iris and the superficial scleral flap tied down more tightly. Postoperatively patients received prednisolone acetate 1% drops two hourly continued for a minimum of 8 weeks. Patients were initially followed up at weeks 1 and 5 or more frequently if required. Thereafter, follow-up was determined by clinical need. Where IOP exceeded the target IOP range, Nd:Yag LGP was performed with a Magna View contact gonioscopy lens (Ocular Instruments, Bellevue, WA, USA). Needle revision with 5-fluorouracil (5-FU) or MMC was performed if IOP was subsequently still elevated. Argon and Nd:YAG iridoplasty were performed either prophylactically to avoid iris prolapse into the goniopuncture or to remove incarcerated iris within it. These postoperative interventions were recorded contemporaneously as part of data collection. Detailed techniques for LGP and iridoplasty have already been described in a previous publication.[19]

Complete (unqualified) success criteria were defined as follows: (A) IOP <19 mm Hg and/or 20% decrease from baseline off any glaucoma medications. Failure in this group was defined as IOP $=>19$ mm Hg or IOP not reduced by 20% of preoperative IOP or IOP <6 mm Hg on two consecutive time points after 3 months; (B) IOP <16 mm Hg and/or 30% drop from baseline off any glaucoma medications. Failure in this group was defined as IOP $=>16$ mm Hg or IOP not reduced by 30% of preoperative IOP or IOP <6 mm Hg on two consecutive time points after 3 months. Partial (qualified) success was defined as any of the above but with at least one topical IOP-lowering medication. Surgical revision for high IOP and loss of light perception were considered a failure by all criteria. Needle revision and LGP were not considered as failures.The time to failure was defined either as the time from surgical treatment to reoperation for glaucoma or as the time from surgery to the first visit in which the patient had hypotony (IOP <6 mm Hg) or inadequately reduced IOP as per success criteria defined above. If a patient had an unsuccessful LGP or needle revision, failure was considered to have occurred on the visit when the decision to do these procedures was taken.

Reoperation for glaucoma or a complication was defined as additional surgery requiring a return to the operating theatre. Serious complications were defined as

Table 1a Pre- and perioperative data

Pre- and perioperative data	*Total*	*PDS*	*PDS-MMC*	P-*value*
Number of eyes	296	151	145	
Age (years)	80.3 ± 6.6	81.05 ± 6.1	79.0 ± 6.8	0.0007
Male/ Female	128/168	52/99	79/66	0.0006
Race				
Caucasian	284	148	136	
Indian	06	02	04	
African	06	01	05	
Preoperative glaucoma diagnoses				0.32
Primary open- angle glaucoma	242	119	122	
Normotensive glaucoma	25	12	13	
Pseudoexfoliation	24	08	16	
Pigmentary	04	02	02	
Primary angle closure glaucoma	12	10	02	
Mean follow-up (months)	63.5 ± 35.3	57.9 ± 34.2	69.7 ± 39.1	0.003
Preoperative glaucoma medications	2.1 ± 1.6	1.9 ± 1.0	2.4 ± 2.0	0.13
CD ratio	0.84 ± 0.1	0.8 ± 0.1	0.85 ± 0.1	0.13
VF mean deviation (dB)	− 13.4 ± 8.0	− 11.9 ± 7.7* (57 patients)	− 14.9 ± 8.0* (54 patients)	0.04
Intraoperative perforations	38	19	19	1.0
Spacer device				0.0008
High-molecular- weight viscoelastic	77	52	25	
SK Gel	168	64	104	
Aqua Flow	37	23	14	
Esnoper	13	12	01	
Healaflow	01	00	01	

Table 1b Snellen VA loss

	Total	*PDS*	*PDS-MMC*
VA loss >2 lines	17	09	08
ARMD	09	05	04
CRVO	01	01	00
Dementia (unable to reliably test refraction or VA)	02	02	00
Progressive retinitis pigmentosa	01	00	01
Advanced POAG	02	00	02
Cause unclear	02	01	01

Abbreviations: CD, cup-disc; PDS, phaco-DS; PDS-MMC, phaco-DS+MMC.

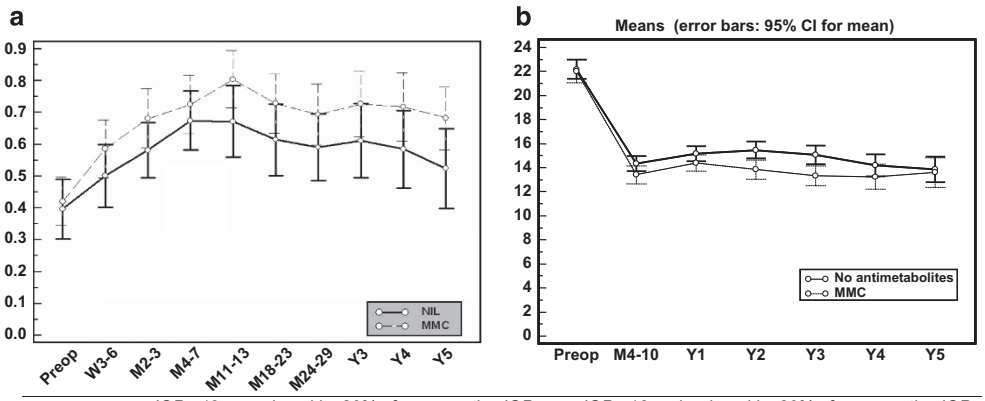
surgical complications associated with loss of two or more lines of Snellen VA for >6 months and/or reoperation to manage the complication. Eyes that tested Seidel positive within the first month of follow-up were classified as wound leaks, whereas those occurring after 1 month were categorised as bleb leaks. Patients who underwent additional surgery were censored from analysis of complications after the reoperation for glaucoma.

Statistical analysis

MedCalc (MedCalc Software, Ostend, Belgium) was used for statistical analysis. IOP changes over time and comparison of IOPs between groups was carried out by analysis of variance (ANOVA) (repeated-measures ANOVA). Non-parametric data such as VA and glaucoma medication changes were analysed by Friedmans ANOVA and Kruskal–Wallis test. Treatment comparisons of time to failure were assessed with Kaplan–Meier survival analysis, univariate log-rank test and Cox's regression analyses. All tests were two-tailed, and *P*-values <0.05 were taken to be significant. Categorical data was analysed by χ^2 test with Yates correction and Fisher's exact test.

Results

Patient demographics and pre- and perioperative characteristics including use and type of spacer device and incidence of intraoperative perforations are shown in Table 1a. Two patients had both eyes included in the study as they had phaco-DS in one eye and phaco-DS with MMC in the other. The mean postoperative follow-up was 63.5 ± 35.3 months. MMC was applied in 145 out of 296 eyes (49%) with no significant difference in mean age between those receiving or not receiving an antimetabolite ($P=0.0007$). There was a preponderance of female patients in the non-MMC group ($P=0.0006$). The vast majority of patients were of white Caucasian



	IOP <19 or reduced by 20% of preoperative IOP		*IOP <16 and reduced by 30% of preoperative IOP*	
	No medications	*With medications*	*No medications*	*With medications*
2 years	81.2% (76.8-85.8%)	89.1 % (85.6-92.8%)	67.2% (61.6-72.9%)	72.4% (67.5-77.8%)
3 years	73.6% (68.5-79.1%)	86.2 % (82.2-90.4%)	61.7% (56.2-67.7%)	68.3% (63.0-74.0%)
5 years	68.3% (62.7-85.2%)	80.0 % (75.0-85.2%)	55.2% (49.3-61.8%)	61.4% (55.6-67.8%)

Figure 1 (a) Mean decimalised VA changes (pre-op, preoperative VA; W, week; M, month; Y, year; error bars—95% confidence intervals). (b) Mean IOP (mm Hg) changes after phaco-DS with 95% confidence intervals over a 5-year follow-up period. Qualified and unqualified success rates for both sets of defined criteria at 2, 3, and 5 years are summarised in the table (bottom).

ethnicity and similarly most patients had a diagnosis of primary open-angle glaucoma (POAG). The MMC group had a higher number of mean preoperative glaucoma drops, but this was not statistically significant. The intraoperative perforation rate was 13% (38/296 eyes). Macroperforation with iris prolapse occurred in 14/38 cases. The most common spacer device used was a reticulated hyaluronic acid implant (SK Gel; Corneal Inc., Paris, France). High-molecular-weight viscoelastic (Healon GV) was used before the adoption of spacer utilisation.

Figure 1a summarises the VA changes over a 5-year period and shows that VA improved significantly after phaco-DS ($P<0.001$). Best-corrected VA was significantly better at year 1 ($P=0.02$) and year 5 ($P=0.04$) in the MMC group. However, a repeated-measures ANOVA with log transformation of decimalised Snellen VA showed no significant difference in completed cases until 2 years postoperatively ($P=0.06$). Table 1b describes any Snellen VA loss of more than two lines by cause and group.

Figures 1b and 2 detail the success rates and survival curves for both augmented and non-augmented groups at different time intervals for the criteria defined above. Success rates in all eyes for criteria A were 89.1% and 80% with glaucoma medications (qualified success) and 81.2% and 68.3% without medications (unqualified success) at 2 and 5 years, respectively. Qualified success for criteria B was 72.4 and 61.4% and unqualified rates were 67.2 and 55.2% for the same time periods. IOP changes after surgery. Repeated-measures ANOVA for 217 eyes, which had completed 3 years of follow-up showed significantly lower IOP in the phaco-DS with MMC group ($P=0.002$). A follow-up of 5 years was completed in 117 eyes and the mean IOPs were significantly lower in the MMC group ($P=0.05$). Cox's proportional hazards for criteria B, however, showed no significant effect of MMC application in the long term ($P=0.2$). Increasing age and LGP were positively associated while the absence of spacer devices was negatively associated with success (Table 2).

Deaths were checked from the hospital database (PASWEB). One hundred and twenty-nine patients (45.7%) died during the observation period, 65 from the non-augmented group and 62 from the MMC group. At the last follow-up visit, 29 eyes (20%) of the MMC group and 30 eyes (19.9%) of the non-augmented group were on medications to control IOP ($P=1.0$). Mean number of topical medications at last follow-up were 0.33 ± 0.74 in the MMC and 0.33 ± 0.73 in the no MMC group ($P=0.9$). The augmented phaco-DS group eyes had a significantly higher chance of undergoing LGP (75.7%) compared with the phaco-DS-only group (51.4%) within 5 years of surgery ($P=0.05$).

Table 3 describes surgical complications and subsequent additional procedures in detail. Complications were observed in 33 eyes (21.8%) of the phaco-DS and 48 eyes (33.1%) of the phaco-DS with MMC group ($P=0.04$). There was only one serious complication: delayed suprachoroidal haemorrhage was observed in an elderly male patient 1 week after phaco-DS MMC and intraoperative perforation. The haemorrhage was successfully drained through two

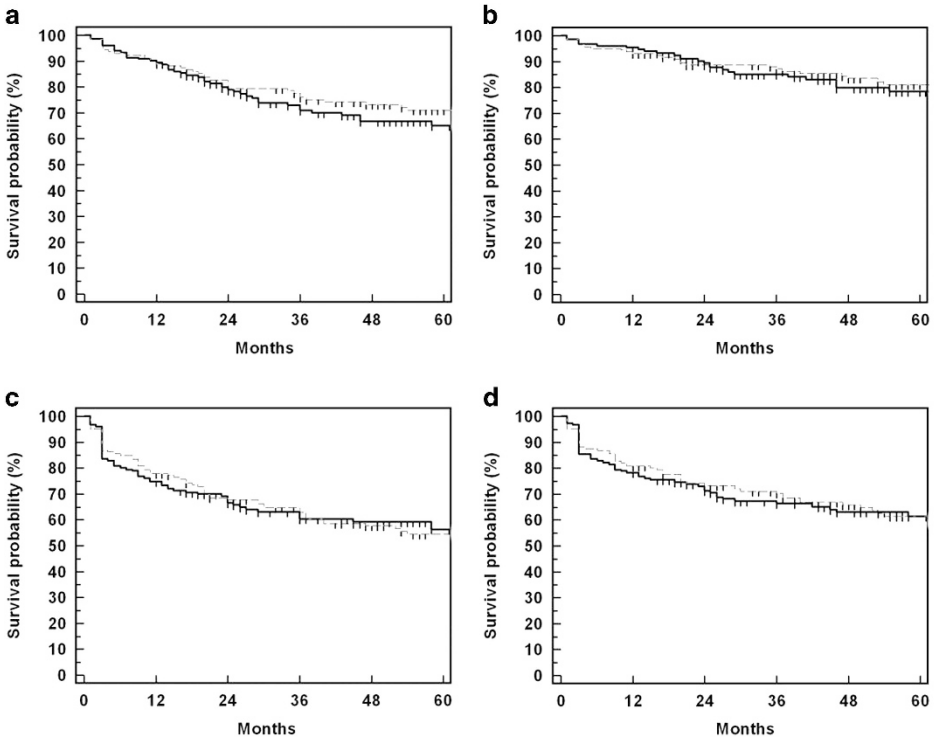


Figure 2 Kaplan–Meier curves for drainage procedure survival probability after phaco-DS (solid lines, phaco-DS with MMC; broken lines, phaco-DS without MMC). (a) IOP <19 mm Hg without medications; (b) IOP <19 mm Hg with medications; (c) IOP <16 mm Hg without medications; (d) IOP <16 mm Hg with medications.

Table 2 Cox proportional hazards model for covariate analysis

Covariate	*Hazard ratio*	*95% CI*	*Multivariate* P-*value*	*Univariate* P-*value log-rank test*
Increasing age	0.96	0.93–0.99	0.02	
Male sex	1.25	0.8448–1.84	0.26	0.14
No spacer device	1.67	1.07–2.58	0.02	0.15
Laser goniopuncture	0.28	0.17–0.45	<0.0001	0.048
Intraoperative perforation	0.54	0.27–1.04	0.07	0.15
Intraoperative MMC	0.79	0.53–1.19	0.26	0.74
Needle revision	1.16	0.74–1.88	0.51	0.006

inferior sclerotomies a month after phaco-DS. Choroidal detachments were observed in two eyes after phaco-DS with intraoperative perforation and in three eyes each following needle revision and LGP. Two patients developed macular folds with slight blurring of vision at 14 months and 4 years, respectively, after uncomplicated phaco-DS with MMC; resuturing of the scleral flap resulted in resolution of both hypotony and maculopathy. Hypotony was observed in six eyes (2.0%) and occurred after LGP or needle revision in four cases. No surgical intervention was required as the patients were asymptomatic and no maculopathy was noted. There were six wound leaks (2.0%), three in each group. Hyphema was uncommon (1.3%) and no delayed bleb leaks were observed in either group. No bleb-related infection or endophthalmitis was observed. The posterior capsule rupture rate was 3% (9/296 eyes).

Discussion

There is a lack of consensus among glaucoma specialists as to the best surgical option for patients needing both cataract and glaucoma surgery. It is generally felt that phacoemulsification before drainage surgery is preferable to avoid the potential for increased scarring and failure caused by postoperative inflammation. For patients with significant cataract who need urgent drainage surgery, many glaucoma surgeons would advocate a combined procedure.[20,21] Traditionally phaco-trab has been shown to be effective albeit slightly less successful for such

Table 3 Surgical complications and subsequent procedures

Surgical complications	*PDS–no MMC (total 151)*	*PDS-MMC (total 141)*
Intraoperative		
Conjunctival flap button-hole	03	02
Capsule zonular dialysis	02	01
Posterior capsular rupture	05	04
Nucleus fragments in vitreous	02	00
Postoperative		
Shallow AC	03	02
Conjunctival wound edge leaks	03	03
Corneal oedema	03	00
Fibrin in anterior chamber	02	00
Hyphema	01	03
Nucleus fragments in anterior chamber	01	00
IOL haptic anterior to iris	01	00
Vitreous in anterior chamber	00	01
Delayed suprachoroidal haemorrhage	00	01
Hypotony		
After surgery	00	02
After LGP	00	03
After needle revision	01	00
Iris synechiae at TDM window	13	18
Iris incarceration into goniopuncture	00	01
Choroidal detachment	03	05
After surgery	02	00
After needle revision	01	02
After laser goniopuncture	00	03
Acute IOP rise >30 mm Hg	01	04
Malignant glaucoma	00	01
Bleb dyaesthesia	00	01
IOL subluxation	00	01
Anterior capsular phimosis	02	00
Capsular block syndrome	01	02
Corneal decompensation	00	01
Subsequent procedures		
Laser goniopuncture	71	90
Laser iridoplasty	10	14
	25	31
Number of eyes undergoing needle revision		
Total number of needle revisions	32	44
MMC	17	36
5-FU	11	07
Bevacizumab	04	01
Success (20% IOP drop with same or less medications until last follow-up)	12/25 eyes	12/31 eyes
Laser capsulotomy	05	01
Selective laser trabeculoplasty	01	00
Scleral flap resuturing	00	01
Revision of DS	00	01
DS with bevacizumab	00	01
Trabeculectomy with MMC	00	01
Sclerotomy for choroidal drainage	01	01
Repositioning of IOL	01	00

patients, with a higher incidence of bleb failure and complications in the long term.[22] Several reports of NPGS describe combined cataract and glaucoma surgery with comparable or even better IOP-lowering outcomes.[14,17] To our knowledge, this case series represents the largest cohort with the longest follow-up of phaco-DS in the literature.

This study confirms the results of previous publications showing that phaco-DS is an effective glaucoma procedure both in terms of lowering IOP and in reducing glaucoma drop requirement.[17,18,23] The 67.2 and 55.2% unqualified success rates for reducing IOP below 16 mm Hg at 2 and 5 years compares very favourably with the National Survey of Trabeculectomy results for trabeculectomy alone, which reported unqualified outcomes of 64% IOP <16 mm Hg as early as 1 year postoperatively.[24] A much more recent multicentre audit of trabeculectomies performed by UK glaucoma surgeons reported an IOP of <19 and 16 mm Hg at 2 years without glaucoma medications in 74% and 68% of eyes, respectively.[25] Our study success rates using the same criteria were highly comparable at 79% and 67%, respectively. In a comparative study, Gianoli *et al*[17] reported success rates of 59% for phaco-DS and 52% for phaco-trab at 1 year, with no differences in the magnitude of IOP drop between the two procedures. In the same study, eyes with phaco-DS had significantly lower rates of hyphema and anterior chamber inflammation.[17] However, our group has previously reported no differences in efficacy or complications between the two procedures.[18] Wishart *et al*[26] reported rates of 94% for phaco-DS at 3 years. The latter group, however, defined success as IOP of 21 mm Hg or less without medication. This level of IOP control may not be sufficient to control progression in eyes with advanced glaucoma.[27]

The slightly higher rate of complications in eyes receiving antimetabolite does not appear to be of clear clinical significance. For example, four eyes of the MMC group had an IOP >30 mm Hg on the first postoperative day. This was either related to viscoelastic left in the anterior chamber or inadequate drainage through the TDM rather than the specific use of MMC. The rate of LGP was higher in the MMC group and contributed to the increase in complications. One of the postulated advantages of NPGS is the lower risk of hypotony and infection related to the conjunctival bleb. However, success in DS has been correlated with the presence of a subconjunctival filtration bleb and a subscleral lake. MMC improves the efficacy of DS, as in trabeculectomy, by decreasing outflow resistance in the subconjunctival tissues and LGP may convert the DS to a full-thickness fistula, thus increasing the probability of hypotony in the long term.[28] In the presence of an avascular bleb, LGP and needle revision may similarly increase the risk of bleb-related infections.[28] Hypotony was observed in 3% of our cohort, which also compares favourably with the hypotonyrate of 7.2% reported by the aforementioned paper by Kirwan *et al*.[25] Over a mean follow-up period of 63.5 months (in 296 eyes), we only observed three serious complications related to hypotony: two eyes required resuturing, whereas one resulted in delayed

suprachoroidal haemorrhage. There were no bleb leaks and bleb-related infections.

LGP is considered an important adjunct to DS in achieving low target IOPs. Reported rates vary from 36 to 67%[19,28–31] The overall rate of LGP in our cohort was 54.4%. Patients in the phaco-DS with MMC group had a significantly greater chance of undergoing LGP (75.7%) compared with the unaugmented phaco-DS group (51.4%) at 5 years after surgery ($P = 0.05$). The difference was only marginally significant and perhaps could be attributed to the lower postoperative target IOPs for the MMC group. LGP, along with increasing age, was positively associated with success, whereas the absence of a spacer device was negatively associated. However, these results should be interpreted with caution as the hazards ratios for LGP and spacer devices had wide confidence intervals (as detailed in Table 2). The association of success with increasing age may possibly be related to a poorer healing response and to increased mortality reducing the length of follow-up.

The role of MMC in increasing IOP success rates after primary trabeculectomy is now well established.[32,33] There is also evidence for a similar role of MMC in primary DS.[34–39] The decision to use MMC during individual surgical cases was difficult to pinpoint from our database. Patients in the MMC group were slightly younger and probably had worse visual field (VF) mean deviation. Unfortunately, VF data was incomplete as it was not collected for earlier procedures (see Tables 1a and 1b). In some cases, the decision not to use MMC was taken during surgery if, for example, the subconjunctival tissues were thin and fragile. The mean postoperative IOP was significantly lower in the phaco-DS with MMC group up to 5 years postoperatively. However, univariate and multivariate actuarial analyses failed to show a significant effect of MMC application ($P = 0.2$).This discrepancy may be because of the confounding effect of the large proportion of censored data related to patients passing away during the follow-up period.

As alluded to above, nearly half (45.7%) of patients in our series had died by their last follow-up period. This may reflect the increased population age of patients undergoing phaco-DS with a mean of 80.3 ± 6.6 years. Similar death rates within comparable age groups undergoing NPGS have been highlighted before, particularly in combined surgery where the average age also appears to be higher compared with NPGS alone.[26] The improvement in VA and the excellent 5-year IOP success rates make combined phaco-DS an attractive option for elderly patients who need glaucoma surgery. These patients also benefit from a significantly reduced need for drop application and a much less demanding postoperative follow-up regimen with decreased hospital visits. The higher proportion of female patients, with their increased life expectancy, may also reflect the advanced patient age noted in our study.

This study confirms the long-term safety and efficacy of phaco-DS as a primary procedure for coexisting cataract and glaucoma. It demonstrates significant IOP lowering outcomes, which are comparable to phaco-trab while also highlighting low complication rates. In the current glaucoma milieu, one must also consider the alternative of 'microincisional' glaucoma surgery, such as trabecular microbypass stents (eg iStent; Glaukos Corporation, Laguna Hills, CA, USA) and ab interno trabeculectomy (Trabectome; NeoMedix Inc., Tustin, CA, USA), combined with cataract surgery. These procedures have the attraction of an excellent safety profile albeit less overall effective IOP reduction when compared with phaco-DS in our study.[22,40–44] Although the glaucoma community must watch and wait for the long-term results of these procedures, phaco-DS currently represents a safe and effective means of combining cataract and glaucoma surgery in the present, with a proven long-term track record.

Summary

What was known before

- Non-penetrating glaucoma surgery is an alternative surgical technique for patients with primary open-angle glaucoma requiring glaucoma drainage surgery. Cataract surgery is commonly necessary in glaucoma patients who may also need glaucoma drainage surgery. The sequence and/or combination of the two procedures is currently debatable.

What this study adds

- This study shows that combined phaco-DS is a safe and effective strategy for the glaucoma patient who needs both cataract and glaucoma drainage surgery. The results confirm that long-term success rates are good and comparable to trabeculectomy with low complication rates and excellent visual outcomes.

Conflict of interest

The authors declare no conflict of interest.

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