INTRAOCULAR PRESSURE CONTROL FOLLOWING MICROTRABECULECTOMY

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SUMMARY

The use of the Kelly Descemet's membrane punch enables the glaucoma surgeon to perform smaller trabeculectomies. The outcome of 'microtrabeculectomy' employing a 2 × 2 mm superficial scleral flap and a 0.75 mm internal osteum was evaluated on 65 eyes of 50 patients (mean age 70 years). The operation site was nasal in left eyes and temporal in right eyes. In the 56 eyes where 5-fluorouracil was not used, the mean intraocular pressure (IOP) on diagnosis was 33.4 mmHg, the mean pre-operative IOP being 25.1 mmHg. After a mean follow-up of 13.4 months (minimum 3 months) following surgery, the mean IOP was 13.4 mmHg with 88% of eyes controlled at <21 mmHg on no medications. Nasally sited microtrabeculectomies resulted in lower IOPs than temporally sited procedures (11.8 vs 14.9 mmHg, $p = 0.003$) at last follow-up visit.

Over the last 25 years, trabeculectomy has become the surgical procedure of choice for chronic open angle glaucoma (COAG) since the first report of its use in humans by Cairns.[1] The 'classical' operation involves a 5 × 5 mm partial-thickness scleral trap-door and a 4 × 1 mm tissue block excision as far posteriorly as the scleral spur. The first modification to Cairns' technique was suggested by Watson in 1970,[2] in which the dissection of the tissue block to be excised is commenced posterior to the scleral spur and is more extensive. More recent modifications to the scleral flap have included the use of a triangular trap-door,[3,4] excising the distal 2 mm of the 5 × 5 mm flap[5] and applying cautery to the lateral margins to reduce its size.[6] The internal dissection has been performed by trephination,[7] sclerectomy[8] with a blade, or with a 2 mm diameter punch.[9]

The success rate of the procedure in primary glaucoma, which is between 67% and 94%,[10] appears to depend more on the pre-operative risk factors than the surgical technique used. An operation involving minimal tissue manipulation with controlled internal fistula formation would seem attractive, provided it was not associated with a reduced success rate or increased morbidity.

In this paper we describe the technique of 'microtrabeculectomy' and report the results of the first 65 cases to be performed on eyes with COAG, pseudoexfoliative and pigmentary glaucoma.

MATERIALS AND METHODS

All eyes with COAG, pigmentary or pseudoexfoliative glaucoma under the care of one consultant (S.A.V.) which had undergone 'microtrabeculectomy' at least 3 months prior to data collection were entered into the study. Cases were consecutive as, once introduced, this method of drainage surgery became the norm on this firm. Aphakic (but not pseudophakic) eyes were excluded. Pre-operative, per-operative and post-operative data was acquired from examination of the case notes and entered onto a microcomputer database. All intraocular pressure (IOP) recordings were performed using slit-lamp-based Goldmann tonometry. As right eyes had, with two exceptions, operations performed at 10:30 temporally and left eyes, again with two exceptions, had similarly placed nasal surgery, IOP results can be compared between these two subgroups. Comparisons were made using the Mann-Whitney *U*-test for unpaired variables. Chi-squared tests were also used where appropriate.

The microtrabeculectomy procedure is performed as follows, following the insertion of a superior rectus suture:

1. Limbus-based conjunctival flap 4 mm from limbus.
2. Wet field cautery to sclera.
3. A 2 × 2 mm scleral trap-door with 3 mm 15° angle Beaver microsharp blade (cat. no. 377513), deepening as the cornea is approached.
4. Paracentesis in the opposite superior quadrant.

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5. Anterior incision into the anterior chamber (AC) at the angle of the scleral flap.
6. Kelly punch 'trabeculectomy' (0.75 × 0.75 mm).
7. Peripheral iridectomy with de Weckers scissors.
8. 2 × 10/0 nylon sutures to the corners of the scleral trap-door.
9. Running 10/0 nylon or Dexon (Davis & Geck) to conjunctiva.
10. BSS (Alcon) via paracentesis to produce a 'bleb'.
11. Air to AC via paracentesis.
12. Guttae (g.) atropine 1% and chloramphenicol ointment.

Post-operative care consisted of g. atropine 1% t.d.s. until the first outpatient visit and g. Betnesol-N (Evans) q.d.s. for at least 1 month following surgery. Reduction of the steroid was at the discretion of the clinic medical staff (consultant or senior registrar/ registrar).

Results of the eyes that had 5-flurorouracil (5FU) supplementation are analysed separately.

RESULTS

In total, 65 eyes of 50 patients had microtrabeculectomy performed, 56 without 5FU (group A) and 9 with 5FU (group B).

Group A

Thirty-one of the 56 operations (52%) were performed on men. Fifty-one eyes had COAG, 3 pseudoexfoliation and 2 pigmentary glaucoma. Fifty-two eyes were from Caucasians, 3 from Afro-Caribbean patients and 1 from an Asian. The mean age of the patients at surgery was 70.1 years (SD 9.3, range 44–85 years). Three eyes had had previous intraocular surgery and 4 had had argon laser trabeculoplasty. Eyes at surgery were receiving a mean of 1.27 antiglaucoma medications, with 42 (75%) eyes on a beta blocker, 13 (23%) on pilocarpine and 7 (12.5%) on dipivefrine 0.1% (Propine, Allergan). Twelve and a half per cent of surgical procedures were performed whilst the patient was taking acetazolamide. Medical treatment had been instigated at a mean of 39 (SD 40) months prior to surgery.

Forty-one operations (73%) were performed by the consultant (S.A.V.), the remainder by surgeons of registrar grade and above under supervision.

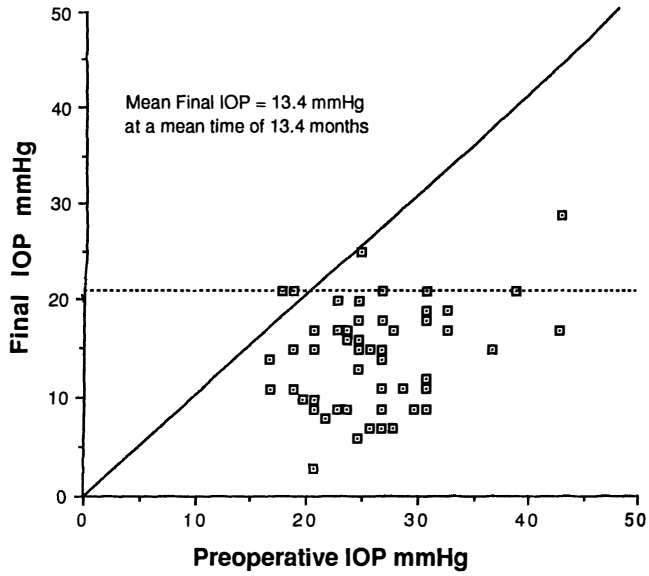

Fig. 1. *Pre-operative intraocular pressure (IOP) on medications versus IOP at the last post-operative visit for eyes in group A (no 5FU). The line of equivalence is shown as a continuous line. The dotted line is at 21 mmHg.*

There were no intra-operative complications noted. The mean post-operative stay in days was 2.8 (SD 2.6), with a range of 1–13 and a median of 2. Fourteen eyes (25%) had post-operative hyphaemas. Patients noted to have hyphaemas did not stay in hospital significantly longer than those without hyphaema (2.21 (SD 1.1) days vs 3.06 (SD 2.9) respectively). Eleven eyes (19.6%) had a shallow AC, defined as less than one half pre-operative depth on clinical inspection, 1 of which required reformation due to corneal/lens touch. The mean post-operative stay was significantly longer in patients with shallow ACs (5.0 days (SD 3.7) vs 3.0 days (SD 2.9), $p = 0.01$). Three eyes required argon laser suture lysis in the early post-operative period.

The mean diagnostic IOP was 33.4 mmHg (SD 8.8), the mean pre-operative IOP being 25.1 mmHg (SD 5.8). The mean IOP on the last post-operative inpatient day was 9.5 mmHg (SD 6.2) and the mean IOP at the last recorded outpatient visit (mean follow-up 13.4 months (SD 7.4), minimum 3 months)

Table I. Risk factors for failure in eyes in group A.

Patient	Eye	Site	Risk factors for failure	Medication required post-operatively
1	L	(t)	Afro-Caribbean	Timolol 0.25%
2	R	(t)	Previous surgery; pilocarpine 28 years	Timolol 0.25% pilocarpine
3	L	(n)	ALT (+ dipivefrine 3 years)	Timolol 0.25%
4	R	(t)	Pilocarpine 4 years	Betaxolol
5	L	(n)	Diabetes (+ dipivefrine 3 years)	Timolol 0.25%
6	R	(t)	Pilocarpine 1 year	None (see text)
7	R	(t)	None	None (see text)

R, right; L, left; (n), nasal microtrabeculectomy; (t), temporal microtrabeculectomy; ALT, argon laser trabeculoplasty. Patients were not consecutive.

Table II. Nasal versus temporal microtrabeculectomies in eyes from group A

	Operation site	
	Nasal	Temporal
No. of eyes	27	29
Mean age, years (SD)	70 (9.7)	69.7 (10.0)
Mean no. of pre-operative medications	1.3	1.1
Duration of medical treatment, months (SD)	43 (44)	36 (36)
Previous surgery	2	0
Previous ALT	2	2
Hyphaema	6	8
Shallow AC	7	4
Reformation of AC	0	1

ALT, argon laser trabeculoplasty; AC, anterior chamber.

was 13.4 mmHg (SD 5.2). Fig. 1 shows the pre-operative IOPs compared with the IOP at the last post-operative visit for all 56 eyes.

Forty-nine eyes (87.5%) consistently had an IOP <21 mmHg on no medications up to and including the last post-operative visit (unconditional success). All but 2 eyes were controlled at an IOP <21 mmHg on supplementary medications (96% qualified success). The two eyes with IOPs >21mmHg had presented with IOPs >40 mmHg and had stable visual fields on no medications at the last visit. Table I indicates pre-operative risk factors for the 7 eyes (of 7 patients) not classified as unconditional successes.

Considering the temporal (29 eyes) and nasal (27 eyes) subgroups separately, there was no significant difference in age, sex, race, pre-operative IOP, pre-operative medications, duration of medication prior to surgery, previous surgery/laser or length of post-operative stay between the two groups (Table II). There was a significantly lower IOP in the nasal group on the last inpatient day and the final post-operative visit ($p = 0.01$ and 0.003 respectively) (Table III).

Group B

Nine eyes had antimetabolite supplementation with 5-fluorouracil (5FU), either following a failed previous procedure on that eye or its fellow, or if the eye was considered to be at risk of failure due to long-term medication, in particular pilocarpine. Single dose 5FU (25 mg/ml) was applied to the scleral flap in 3 cases, multiple post-operative subconjunctival injections of the same concentration (in 5 mg aliquots) being used in the remaining 6 eyes.

Table III. Intraocular pressure (mmHg) of nasal and temporal subgroups of eyes from group A

	Operation site		
	Nasal	Temporal	*p*
Pre-operatively	23.9 (5.1)	26.3 (6.3)	0.08
Last inpatient day	7.9 (5.3)	10.9 (6.8)	0.01
Last outpatient visit	11.8 (4.8)	14.9 (5.2)	0.003

Statistics by the Mann–Whitney *U*-test. Standard deviations in parentheses.

The mean diagnostic IOP, pre-operative IOP and IOP at last post-operative visit were 33.6 mmHg (8.2), 24.0 mmHg (4.7) and 13.8 mmHg (5.4) respectively, i.e. not significantly different from group A. Only 1 eye had a shallow AC in this group. The only significant difference between eyes from group A and group B was found to be duration of medical treatment prior to surgery (mean 39 months (SD 40) vs mean 109 months (SD 114), $p = 0.015$).

DISCUSSION

The aim of trabeculectomy is to reduce IOP to a level which curtails or significantly slows the process of optic nerve excavation and subsequent field loss. The mode of action in trabeculectomy is predominantly by external filtration[6,11] as the majority of successful cases have a visible bleb. Filtration occurs either through the scleral flap if very thin (and the deliberate formation of such a flap has been claimed to produce lower IOPs[12]) or around the margins of the trap-door.[6] Our method of trabeculectomy combines a small trap-door (2×2 mm) with a 0.75–1 mm internal osteum. To our knowledge there has been only one previous report of the use of a 2×2 mm trap-door in which 17 eyes (13 with COAG) were compared with 11 eyes (7 with COAG) undergoing 4×4 mm scleral incisions.[13] IOP control was similar in the two groups and although the surgical technique did not include the use of a punch, it was otherwise similar to the one performed in this study. In addition the size of the internal osteum has not been shown to influence the long-term control of IOP.[14]

The IOPs in our study are slightly lower but not dissimilar to those quoted by other authors using a more classical technique at a mean follow-up of 1 year.[13,15–18] Our unconditional success rate of 88% is encouraging at this stage but longer follow-up is necessary to ensure that failures at a later stage are not more numerous than in previous reports.

Our study confirms the observation by Sanders *et al.*[17] that nasal trabeculectomies result in lower IOPs than those performed at a temporal site. A previous report from our unit has shown that there is

no significant asymmetry between IOPs recorded from right and left eyes of individuals undergoing surgery to both eyes at the 12 o'clock position.[19] It is therefore unlikely that our surgical bias where all but two right eyes had temporal surgery was influential. Unlike Sanders *et al.*[17] we did not encounter problems with surgical exposure resulting in conjunctival wound leakage sufficient to resuture the wound. This is probably because the conjunctival wound does not have to be placed so posteriorly in microtrabeculectomy and is of shorter length.

In Cairns' original report,[1] 41% of eyes had a flat AC following surgery. A 20% incidence of shallow AC in a modern series may appear high, but it should be emphasised that this was graded clinically without formal measurement, and many of these eyes may have had shallow ACs prior to surgery. All but the 1 eye that required reformation in group A regained full depth spontaneously and this was the only eye to be graded as having a flat AC. The use of 5FU with microtrabeculectomy did not appear to increase the rate of shallow AC. It is, however, important to note that there were more cases of shallow AC in our nasal group (Table II), although this did not reach statistical significance.

Our overall hyphaema rate of 25% is not excessive when compared with previous reports, in which rates vary from 7% to 53%.[18,20] Although effectively a retrospective study, any fluid level of blood in the anterior chamber was recorded as a hyphaema. This is supported by the fact that patients with hyphaema did not stay longer in hospital than those without this complication. Recently Konstas and Jay[4] have suggested that the rate of hyphaema can be reduced by removing only corneal tissue when performing the internal osteum. The use of the Kelly punch allows the surgeon to remove smaller tissue blocks than is possible with a blade or scissors and creates clean cut edges. We too advise limiting the internal osteum to tissue anterior to the scleral spur.

Although we have no experience in the use of fornix-based conjunctival flaps with microtrabeculectomy, we would counsel against their use with this technique. Fornix-based flaps are associated with aqueous leakage without antimetabolites[21,22] and have been found to be a risk factor in eyes which have required reformation of the AC.[23] Conventional trabeculectomy with single-dose 5FU using a limbus-based flap results in no wound leakage.[24] In this study none of the eyes to have either single- or multiple-dose 5FU with microtrabeculectomy had wound leakage.

Three of the 56 eyes in group A and 1 in group B (6% overall) required argon laser suture lysis in the early post-operative period.[25] This is easily performed with microtrabeculectomy as the sutures to be cut are nearer the limbus than in conventional surgery.

All but 1 of the eyes not to be classed as unconditional successes had recognised risk factors for failure.[15,26] We consider that microtrabeculectomy allows the surgeon to perform a controlled procedure with less tissue disruption and a chance of success that is at least the equivalent of conventional surgery. It is of particular advantage when 'virgin' conjunctiva at the limbus is in short supply, allowing the operation to be performed superiorly when otherwise an inferior approach would be required.

As we see no disadvantages to date, we advocate its use as the method of choice when filtration surgery is required.

The authors have no financial interest in the Kelly punch or Stortz Ltd.

Key words: Glaucoma, Intraocular pressure, Kelly punch, Trabeculectomy.

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