

COMPARISON OF THE TECHNIQUES OF TRABECULECTOMY IN INTRAOCULAR PRESSURE CONTROL – A 5-YEAR REVIEW

AO HASSAN FRCS, FRCOph., FWACS

*AO OGUNRO FWACS

A HARRIMAN MRCOph

F O OLUYADI FWACS

O OKONKWO FRCS

O ODERINLO FRCS

SA OKE DO

Eye Foundation Hospital, 27B, Isaac John Street, Ikeja GRA, Lagos

SUMMARY

Aims and Objectives: To review the effectiveness of the various techniques of trabeculectomy used at the Eye Foundation Hospital Lagos.

Materials and Methods: A retrospective study of all consecutive trabeculectomies done from 1995 to 2000 was carried out. 183 eyes of 130 patients were classified into 4 groups, based on the type of technique used.

Group A: Trabeculectomy using a fornix or limbal-based conjunctival flap and scleral flap without 5-fluorouracil (5-FU).

Group B: Trabeculectomy with 5-fluorouracil. (5-FU).

Group C: Modification of trabeculectomy by triangular sclerectomy from the lateral sides of the scleral flap with 5-FU (modified trabeculectomy with 5-FU).

Group D: Modified trabeculectomy without 5-FU.

The number of eyes in each group was: Group A - 20, Group B - 113, Group C - 18 and Group D - 32. The information obtained formed the database for analysis using EpiInfo 6.

Main Outcome Measures: Intraocular pressure maintained below 15mmHg is classified as 'absolute success'. Intraocular pressure between 16 and 20mmHg, with or without medication, is 'classified success', while over 20mmHg is considered as 'failure'. The other outcome measures are mean intraocular pressure and the number of anti-glaucoma drugs used post-operatively.

Results: During the five-year period, the mean intraocular pressure was consistently lowest in group C, followed by group D, group B, and group A, in order of

increasing mean intraocular pressure. The mean intraocular pressure was lower than 15mmHg in all the groups at the end of the 5-year period.

The number of patients on medication was reduced from 173 preoperative to 42 (0.23%) postoperatively.

Conclusions: Modification of the scleral flap yielded a better intraocular-pressure lowering effect. Long-term drainage was further improved by 5-fluorouracil enhancement.

Key words: trabeculectomy, intraocular pressure, 5-fluorouracil, sclerectomy

INTRODUCTION

Numerous procedures have evolved for the surgical treatment of chronic open-angle glaucoma since 1968 when Cairns first reported a remarkable high success rate for trabeculectomy.¹ Various modifications had been tried successfully by many other ophthalmologists.² The reports by other investigators and Cairns' have established that trabeculectomy is mostly a guarded filtering procedure. This conclusion is based on the fact that histological examination of blocks of corneoscleral tissues obtained in trabeculectomy did not show the presence of trabecular meshwork, the Schlemm's canal or both. There was no relationship between the success of the procedure and the inclusion of trabecular meshwork or Schlemm's canal, or both, in the excised tissue.^{3,1,6,7,8} Trabeculectomy has a very high success rate, however, certain eyes are known to be at high risk of failure due to scarring of the conjunctival bleb. In addition, it is generally accepted to be less

* Author for correspondence

successful in patients of African origin. In favour of the use of antifibrotic agents in primary filtering surgery is the observation that surgery performed without them generally yields suboptimal results with half of the patients requiring supplemental medical therapy within two years.¹⁰ Mean intraocular pressure (IOP) 5 years after surgery is usually 16-21mmHg, and 35% -58% of patients who have glaucoma with pressure in this range have been noted to suffer progressive visual field loss within those 5 years.¹¹

Previous reports of the use of low dose 5-fluorouracil and of mitomycin C- in primary filtering surgery have shown that they yield lower mean pressures. In a prospective randomized multi-centre study, eyes treated with postoperative 5-fluorouracil had significantly lower pressures and required fewer post-operative antiglaucoma medications than the control eyes.¹² It is suggested that episcleral fibroblasts play a more important role than those from Tenon's capsule, in determining the vascularity of the bleb¹³ and aqueous filters through a sclera incision that has failed to heal completely.^{9,13} In an effort to improve drainage on a long-term basis and reduce bleb fibrosis and vascularity, trabeculectomy was modified.

Practical management of glaucoma will continue to be driven by IOP, disc, and visual field findings in individual patients on follow-up examination.¹⁴

METHOD

A retrospective study of 200 eyes of 130 consecutive patients who had trabeculectomy at Eye Foundation Hospital, between April 1996 and May 2002, and who were followed up for at least 3 months was carried out. 17 eyes were disqualified due to non-availability of their pre-operative IOP. Relevant information obtained from the files formed the database for analysis using EpiInfo 6. The overall P-value for success of surgical outcome was determined. Indications for surgery were:

1. Poorly controlled IOP on maximum drug therapy.
2. Advance glaucomatous disc damage.
3. Bilateral glaucoma with visual loss in fellow eye.

The subjects were randomly selected for placement in the four groups. In this study, an intraocular pressure (IOP) of 15mmHg or lower, with or without medication, (for all the categories) was considered absolute success, IOP between 16-20 mmHg was classified success, and IOP above 20mHg was considered as failure (table 4).

SURGICAL TECHNIQUES

Trabeculectomy only (Technique A) Cairn's Technique

1. Fornix or limbal-based conjunctival incision made through the conjunctiva and the underlying Tenon's capsule to the level of the episclera. Cauterization was done with wet-field cautery.

2. Partial thickness rectangular 4x4mm or triangular scleral flap is raised up to clear cornea and sufficiently far forward. A fistula is created into the anterior chamber by excising a rectangular block of trabecular meshwork with a knife and Vannas' scissors. Two small vertical cuts are made, each 1mm from the lateral extreme of the scleral bed, starting just anterior to Schwalbe's line and extending posteriorly to about the level of the scleral spur and about 1 mm in length. Vannas' scissors are then inserted into one of these incisions and the inner blade extended towards the opposite incision. The blade is extended approximately at the level of Schwalbe's line. This creates a flap about 1x2mm, hinged at approximately the level of the scleral spur. The iris is usually seen prolapsing through the fistula. The iris is gently retracted and iridectomy is done. The scleral flap is closed with 8/0 virgin silk at the posterior lip x 2 sutures. The conjunctiva is closed with 8/0 continuous suture in limbal-based conjunctival flap and two to three sutures in fornix-based conjunctival flap.

Trabeculectomy with 5-Fluorouracil (Technique B)

Technique A with application of 5-fluorouracil 50mg/ml soaked in Weck sponge by contact between the conjunctival flap and sclera for 3 minutes before the scleral flap is fashioned.

Modified Trabeculectomy with 5-Fluorouracil (Technique C) (fig.1)

Technique B in addition to excision of a triangular wedge from the lateral sides of rectangular partial thickness scleral flap (sclerectomy), with application of 5-fluorouracil as described earlier on (see figure 1).



Figure 1. Diagram showing the design of partial thickness scleral flap with wedge sclerectomy in modified trabeculectomy

Modified Trabeculectomy (Technique D)

Surgical procedure as in technique C without the application of 5-fluorouracil.

RESULTS

There were 45 females and 85 males at presentation. Seventy patients had bilateral trabeculectomy, 27 had left trabeculectomy and 33 had right trabeculectomy. Total number of eyes were 183. Seventeen eyes were disqualified due to non-availability of their preoperative IOP.

- Number of eyes that had technique A (trabeculectomy without 5-FU) = 20
- Number of eyes that had technique B (trabeculectomy + 5FU) = 113
- Number of eyes that had technique C (modified trabeculectomy + 5FU) = 18
- Number of eyes that had technique D (modified trabeculectomy without 5-FU) = 32

Ten eyes were not on any medication, 46 eyes were on 1 medication, 70 eyes were on 2 medications, 54 eyes were on 3 medications and 3 eyes were on 4 medications (table 2). Preoperative intraocular pressures ranged from 7- 60mmHg. The cup-disc ratios ranged between 0.2 – 1.0 (table 1), only 156 eyes had a record of CDR recorded at first visit.

Table 1. Cup-Disc Ratio (CDR) in the eyes

CDR	No of Cases
0.2	1
0.3	3
0.4	10
0.5	10
0.6	17
0.7	17
0.8	26
0.85	2
0.9	58
0.95	5
1	7
Total	156

Table 2. Previous medications

No. of drugs before Surgery	No of Cases
0	10
1	46
2	70
3	54
4	3
Total	183

Table 3. Showing standard deviation and mean intraocular pressure with different Techniques at various times

		Surgery a	Surgery b	Surgery c	Surgery d
Pre Op	Mean IOP ± S.D	26 ± 10.1	23.41 ± 8.36	24.67 ± 10.29	25.28 ± 10.1
	No of cases	20	113	18	32
Week 1	Mean IOP ± S.D	7.75 ± 3.67	7.66 ± 4.6	6.08 ± 4.21	7.68 ± 4.5
	No of cases	12	89	13	25
	P-value	0.000002	1.59E-37	0.000001	1E-10
Week 4-8	Mean IOP ± S.D	13.5 ± 4.13	11.38 ± 3.63	11.56 ± 6.22	13 ± 6.68
	No of cases	14	98	16	32
	P-value	0.0001	2.42E-29	0.0001	0.0000003
Month 3-6	Mean IOP ± S.D	13.89 ± 2.92	12.2 ± 4.36	12 ± 4.33	11.19 ± 4.35
	No of cases	19	88	15	32
	P-value	0.00001	1.53E-23	0.0001	7E-10
Month 7-12	Mean IOP ± S.D	14.23 ± 3.98	13.3 ± 5.47	10.64 ± 5.3	11 ± 3.67
	No of cases	13	91	11	25
	P-value	0.0004	3.17E-19	0.0003	0.00000001
Year 2	Mean IOP ± S.D	14 ± 3.52	14.05 ± 5.13	10.17 ± 2.4	12.33 ± 5.18
	No of cases	12	60	6	21
	P-value	0.0005	3.05E-13	0.0027	0.000002
Year 3	Mean IOP ± S.D	16.33 ± 5.77	13.19 ± 4.77	12 ± 0	11.89 ± 4.13
	No of cases	9	37	2	18
	P-value	0.0133	1E-10	0.1065	0.000002
Year 4	Mean IOP ± S.D	15.89 ± 6.53	13.68 ± 7.09	12 ± 0	13.75 ± 6.48
	No of cases	9	19	1	16
	P-value	0.0111	0.000005		0.0001
Year 5	Mean IOP ± S.D	14 ± 3.35	12.89 ± 7.62	10 ± 0	11.25 ± 2.93
	No of cases	6	9	1	12
	P-value	0.0097	0.0004		0.00003

Table 4 . Showing the number and percentage of eyes in each success group

		IOP (mmHg)	Surgery a		Surgery b		Surgery c		Surgery d	
Pre-Op	N=20	No. of patients	20		113		18		32	
		0 - 15	3	15%	15	13.3%	0	0	3	9.4%
		16 - 20	2	10%	32	28.3%	7	38.9%	9	28.1%
		>20	15	75%	66	58.4%	11	61.1%	20	62.5%
Week 1	N=12	No of patients	12		89		13		25	
		0 - 15	12	100	85	95.5%	13	100%	23	92%
		16 - 20	0	0	3	3.4%	0	0	2	8%
		>20	0	0	1	1.1%	0	0	0	0
3 months Post-Op	N=14	No of patients	14		98		16		32	
		0 - 15	10	71.4%	83	84.7%	13	81.3%	24	75%
		16 - 20	4	28.6%	13	13.3%	2	12.5%	6	18.8%
		>20	0	0	2	2.0%	1	6.2%	2	6.2%
6 months Post-Op	N=19	No of patients	19		88		15		32	
		0 - 15	14	73.7%	71	80.7%	13	86.6%	26	81.3%
		16 - 20	5	26.3%	12	13.6%	1	6.7%	5	15.6%
		>20	0	0	5	5.7%	1	6.7%	1	3.1%
1 year Post-Op	N=13	No of patients	13		91		11		25	
		0 - 15	8	61.5%	66	72.5%	9	81.8%	23	92%
		16 - 20	3	23.1%	17	18.7%	2	18.2%	1	4%
		>20	2	15.4%	8	8.8%	0	0	1	4%

DISCUSSION

In eyes that had surgery a, 75% had preoperative IOP higher than 20mmHg, 61.5% had IOP less than 15mmHg (absolute success) 1 year postoperative, 2 eyes (10.53%) were on 2 medications at 6 months, 89.5% had no medication (table 4). In patients who had surgery b, 58.4% had preoperative IOP greater than 20mmHg. At 1 year postoperative, 72.5% were in the absolute success group. At 6 months, 8 eyes (9.1%) had more than 1 medication and an additional 2 (10.99%) at 1 year. At 6 months, 90.9% had no medication and 89% had no medication at 1 year. This is comparable with results of the Ingrid U study,¹⁸ in which 11.8% were receiving medication post-trabeculectomy at 1 year, with the use of adjunctive Mytomycin C (MMC), while 88.2% were not. Ekwerekwu and Ezepue¹⁵ in their pilot study, found that 1 out of 13 eyes was on medication one year postoperative. In surgery c, 1 patient (7.1%) was on 3 medications at 3 months postoperative; 92.9% of the patients were not on any medication at 6 months and 1 year postoperative. In surgery d, at 1 year, 1 eye (3.1%) was on 3 medications while 93.9% had no medication.

It was noticed that patients who had been treated with technique A had a higher average postoperative pressure than those treated with the other techniques. A greater reduction was noticed for techniques C and D

(table 3).

The mean IOP at 24 months in surgery a, was 14mmHg ± 3.52mmHg, in surgery b, 14.05mmHg ± 5.13mmHg, in surgery c 10.17mmHg ± 2.4mmHg, and in surgery d, 12.33mmHg ± 5.18mmHg (table 3). In a similar study carried out by Singh et al.,¹⁶ in black patients, it was found that those who had 5-FU enhancement had higher mean postoperative IOP (17.1mmHg) than those with MMC enhancement (14.7mmHg) at mean follow-up of 17.7 months. Kupin et al¹⁷ achieved significantly lower mean postoperative IOP in patients who received adjunctive MMC in primary trabeculectomy than in the control group, with respective mean IOP of 10.3mmHg ± 7.1 mmHg versus 14.5mmHg ± 5.1mmHg at 6 months P-value 0.02, 10.5mmHg ± 4.9mmHg versus 14.5mmHg ± 4.4mmHg at 12 months P-value 0.01 and 10.0mmHg ± 3.1mmHg versus 17.2mmHg±3mmHg at 18 months P-value 0.004.

In another study, sclerectomy was found effective in lowering the risk of scleral fibrosis and for reducing IOP from a preoperative mean of 27mmHg ± 5.4mmHg to a postoperative mean of 16.4mmHg ± 3.8mmHg at 24 months.¹⁸

The pressure lowering effect of sclerectomy in surgeries c and d appears to be greater than the effect in Cairn's technique (surgeries a and b).

Episcleral fibroblasts play a more important role than Tenon's capsule in determining the vascularity of the bleb.¹³

In conclusion, this study has shown that modification of trabeculectomy is an effective method of achieving low intraocular pressure in Africans. It is an attractive alternative to Cairn's technique. It compares favorably with MMC and 5-FU enhancement.

REFERENCES

1. Cairns JE. Trabeculectomy preliminary report of a new method *Am J Ophthalmol* 1968; **66(6)**: 73.
2. Benedict O. The mode of action of trabeculectomy. *Klin Monatsu Augenheiko* 1975; **167**: 679.
3. Watson P. Trabeculectomy: A modified ab externo techniques *Am Ophthalmol* 1970; **2**: 199.
4. Thyer HW and Wilson P. Trabeculectomy *Br J Ophthal* 1972; **56**: 37.
5. Limen E. Microsurgical trabeculectomy 'ab externo' in glaucoma. *Trans Ophthal Soc UK* 1969; **89**: 475.
6. Cairns JE. Trabeculectomy. *Trans Am Acad Ophthalmology* 1972; **76**: 384.
7. Ridgway A, E Rubinsteine and Smith VH. Trabeculectomy *Br J O* 1972; **56**: 511.
8. Schwartz AL and Anderson DR. Trabecular surgery. *Arch Ophth* 1974; **92**: 134.
9. Spencer WH. Histological evaluation of microsurgery glaucoma. *Trans Am Otolaryngology* 1972; **76**: 389.
10. Liebman JM, Ritch R, Mermo M et al. Initial 5-fluorouracil trabeculectomy in uncomplicated glaucoma. *Ophthalmology* 1991; **98**: 1036-1041.
11. Palmberg PF. The role of IOP in success or failure of medical and or surgical therapy. In: Preferred Practise Pattern for Primary Open Angle Glaucoma. Appendix I. AAO, San Francisco, Calif. 1992.
12. Goldenfeld M, Krupin T, Ruderman JM. 5-fluorouracil in initial trabeculectomy, a prospective randomized in multi-centre study. *Ophthalmology* 1994; **101**: 1024 -1029
13. Susanna MMC without conjunctival and Tenon's Capsule touch. *Ophthalmology* 2001; **108(6)**.
14. Editorial. *Ophthamology* 2001; **108(6)**.
15. Ekwerekwu CM, Ezepeue UF. Trabeculectomy with intraoperative 5-Fluorouracil in Enugu, South-Eastern Nigeria: A pilot study. *Nig J Ophthalmol* 2000; **8(1)**: 21-28.
16. Singh K, Byrd S, Egbert PR, Budenz D. Risk of hypotony after primary trabeculectomy with antifibrotic agents in a black West-African population. *J Glaucoma* 1998; **7(2)**: 82-85.
17. Kupin TH, Juzych MS, Shin DH, Khatana AK, Oliver MM. Adjunctive mitomycin C in primary trabeculectomy in phakic eyes. *Am J Ophthalmol* 1995; **119(1)**: 30-9.
18. Andreanos DG, Papaconstantinon J, Vergados J, Chalkiadakis and GT Georgopillos. Deep Sclerectomy with use of Mytomycin C. Shalom www.kenes.com/glaucoma2001/IGSAbstract/371cchttp.