

Trabeculectomy

A follow-up study

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Trabeculectomy, introduced by Cairns (1968) and modified by Watson (1969), has become an accepted part of the armamentarium of the glaucoma surgeon. It has been shown to succeed by means of external filtration into a well-covered diffuse and posterior drainage bleb (Ridgway, Rubinstein, and Smith, 1972; Thyer and Wilson, 1972; D'Ermo and Bonomi, 1973) and it has proved to be free of many of the troublesome early complications of previously devised filtration operations (Ridgway and others, 1972). It has also proved reasonably successful in African and Asian eyes (Chatterjee and Ansari, 1972). However, longer term follow-up has not been adequately reported and it is the purpose of this paper to describe such a study.

Material

In the period December, 1969, to May, 1972, 203 trabeculectomy operations were performed on 161 patients under the care of consultants at the Birmingham and Midland Eye Hospital and Selly Oak Hospital, Birmingham. 180 eyes of 140 patients were accessible to follow-up at least 1 year after operation (Tables I and II). Of these, 31 eyes of 24 patients had been subjected to surgery immediately after an attack of acute angle-closure glaucoma (Table I), usually because of difficulty in medical control of intraocular pressure. Since it is probable that some of these eyes would have settled satisfactorily after peripheral iridectomy alone, thus artificially improving the success rate of the series, they have been excluded from subsequent discussion.

Table I *Cases submitted to trabeculectomy*

<i>Result</i>	<i>No. of patients</i>	<i>No. of eyes operated</i>
Died	5	5
Defaulted	7	8
Untraceable	9	10
	} 21	} 23
Accessible to follow up	140	180
Acute glaucoma*	25	31
Available for further analysis	116	149

*Eyes operated for acute glaucoma are not analysed further

Table II *Numbers of eyes and patients available for analysis*

<i>Type of glaucoma</i>	<i>No. of patients</i>	<i>No. of eyes operated</i>
Chronic simple	51	69
Chronic angle-closure	44	59
Haemorrhagic	13	13
Post-traumatic	5	5
Developmental	3	3
Total	116	149

The remaining 149 operations were performed on the eyes of 116 patients, all of whom showed evidence of disc and/or field changes consistent with chronic glaucoma, as well as raised intraocular pressure. The diagnoses are listed in Table II and individual details in Table III.

Table III *Clinical particulars of 116 patients (149 eyes) available for analysis*

<i>Type of glaucoma</i>	<i>Sex</i>		<i>Eye</i>	
	<i>Male</i>	<i>Female</i>	<i>Right</i>	<i>Left</i>
Chronic simple	27	24	35	34
Chronic angle-closure	15	29	32	27
Haemorrhagic	10	3	7	6
Post-traumatic	4	1	3	2
Developmental	1	2	2	1
Total	57	59	79	70

Method

Modifications of the technique of Watson (1969) were used by both senior staff and residents in training, all but one surgeon using $\times 6$ to $\times 16$ binocular operating microscopes. The one exception used a $\times 4$ binocular operating loupe.

There was some individual variation in technique but in all cases a large limbus-based conjunctival flap was turned down, a 5 mm. square limbus-based half-thickness scleral flap was marked out and dissected well past the scleral spur into the cornea, and a 3 mm. square inner lamellar sclero-corneal excision straddling the scleral spur was made. A peripheral iridectomy was performed through the scleral trap door and the scleral wound was closed with between three and seven interrupted 8/0 virgin silk sutures. The conjunctiva was then closed with 8/0 virgin silk or 6/0 collagen by either interrupted sutures or a continuous locked suture.

One simple method used to carry out the scleral dissection was to mark out the external scleral flap with the sharp edge of a razor-blade fragment. The lamellar dissection was then performed with the blunt edge of the same blade, short upward strokes with the sharp edge at the margins of the flap being used to maintain the correct depth. The inner excision was started by making an incision in the cornea with the razor-blade fragment. At this stage a little aqueous was usually lost and the iris prolapsed. A peripheral iridectomy was then performed, and the scleral incision was continued in a clockwise manner until three sides of the inner 3 mm. square of sclera were free. The free edge of this inner trap-door was then raised and the ciliary body was freed from the scleral spur and the trabecular meshwork by gentle strokes with the blunt edge of the razor blade. Finally, the fourth side of the inner scleral excision was cut and the specimen removed. Closure was as described above.

Postoperative treatment with gutt. Atropine 1 per cent and gutt. Predsol-N twice daily was continued until the uveal inflammatory response had subsided, usually in 4 to 6 weeks. Fourteen eyes received oxyphenbutazone four times a day for 2 weeks after the operation, and 65 other eyes were given 20 mg. repository steroid subconjunctivally at the end of the operation.

Results

CHRONIC SIMPLE GLAUCOMA

The intraocular pressure was maintained at or below 21 mm.Hg in 60 out of 69 eyes, eleven eyes requiring local Pilocarpine and/or Adrenaline postoperatively (Fig. 1). Drainage blebs formed in 42 of the 49 eyes controlled by surgery alone, in three of the eleven eyes

which required medical treatment in addition to surgery, and in two of the nine eyes in which the intraocular pressure was above 21 mm.Hg despite medical treatment (Table IV).

Table IV Results in largest groups of cases

Type of glaucoma	Result of treatment			
	Bleb	Controlled by surgery alone	Controlled with local treatment	Not controlled
Chronic simple	Bleb	42	3	2
	No bleb	7	8	7
Chronic angle-closure	Bleb	47	0	0
	No bleb	3	4	5

The two eyes with blebs in this last group both had intraocular pressures of 22 mm.Hg, and were not receiving antiglaucoma medication at their last examination. In 47 eyes, 23 were noted to have blebs at the first dressing 24 hours after surgery, but 24 eyes developed blebs later, from the 2nd to 10th (average 4th) postoperative day. The date of appearance of a bleb was not noted in seven eyes. Failure of control of intraocular pressure by surgery alone in twenty eyes occurred within one year of operation in sixteen cases (Fig. 2). Two of the late failures followed cataract extraction.

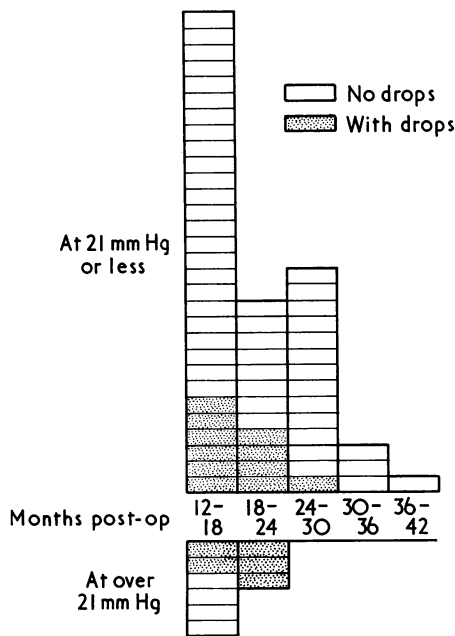


FIG. 1 Results in chronic simple glaucoma with and without drops

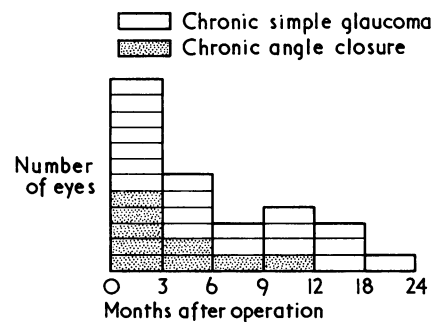


FIG. 2. Date of failure of surgical control of intraocular pressure

Hyphaema was present in eleven eyes at the first dressing, persisting from 1 to 9 days (average 3.5). Secondary hyphaema developed in two eyes during the first postoperative week. One was minor, clearing in 2 days, and the eye did well. The second lasted for 19 days and this eye now requires gutt. Pilocarpine 4 per cent. four times a day for control of pressure.

The anterior chambers of two eyes were flat at the first dressing. One had re-formed by the 2nd and the other by the 3rd day. A third eye lost its anterior chamber on the 5th day and was found to have a leaking conjunctival wound which required re-suturing. One further patient presented at 3 weeks with epiphora and a deep anterior chamber. His eye was found to have a leaking conjunctival dehiscence and this also required re-suturing. One patient developed small ciliary staphylomata over the site of the inner scleral excision in both eyes. Intraocular pressure had not been controlled by operation in either case and the patient suffered from chronic rheumatoid arthritis. No other such case occurred in this series.

Visual acuity fell by more than two Snellen lines in five of the 49 eyes controlled by surgery alone, in three because of progression of field loss and in two because of the development of cataract. Field loss progressed in one further eye despite control of intraocular pressure, and the visual acuity of one other eye in this group fell from 6/18 to 6/36 because of progressive lens opacities. In the 20 eyes in which the intraocular pressure was not controlled by surgery alone, the visual acuity fell by more than two Snellen lines in nine. The visual loss was due to the development of lens opacities in two eyes, progression of pre-existing lens opacities in two eyes, and progressive field defect in five eyes.

Postoperative ocular hypotension of less than 10 mm.Hg occurred in twelve eyes. In ten it was transient, but in two it persisted for more than 3 months, at a level of 8 mm.Hg in one eye and 9 mm.Hg in the other. One of the transiently hypotensive eyes developed a cataract and one other lost visual field. The other ten did not develop further complications.

CHRONIC ANGLE-CLOSURE GLAUCOMA

An intraocular pressure of 21 mm.Hg or less was obtained in fifty eyes by surgery alone and in a further four with the addition of local Pilocarpine drops. In five eyes it was not possible to reduce the intraocular pressure to 21 mm.Hg or less (Fig. 3). The intraocular pressure of two of the failed eyes was subsequently controlled by further surgery, thermal sclerotomy in one and a second trabeculectomy in the other. Trabeculectomy had been repeated in a further two eyes with chronic angle-closure glaucoma but had failed to control intraocular pressure in both.

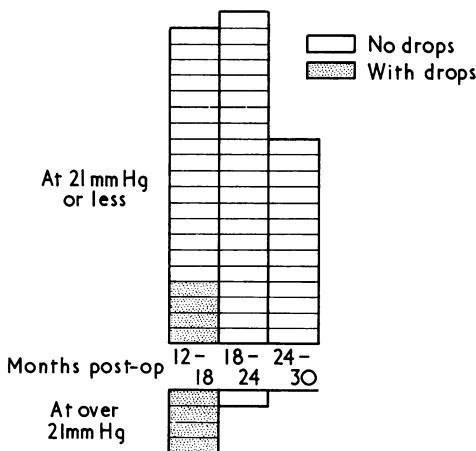


FIG. 3 Results in chronic closed-angle glaucoma with and without drops

Drainage blebs formed in 47 out of the fifty eyes controlled by surgery alone, and in none of the others. 25 blebs were noted as present at the first dressing, and sixteen appeared between the 2nd and 16th (average 4th) day. Insufficient information was available on the

time of appearance of the other six blebs (Table IV). Failure to control intraocular pressure by surgery alone in nine eyes occurred within one year of operation in all cases (Fig. 2). One eye failed after cataract extraction.

Two eyes had hyphaema at the first dressing: both had cleared by the 2nd postoperative day. One eye developed a minor secondary hyphaema on the 3rd day which cleared by the 5th. One eye had a flat anterior chamber for 4 days after surgery. The operation had proved difficult, iris presenting and being impossible to reposit, and a broad iridectomy had been performed. However, a bleb formed at 14 days and the pressure has remained well controlled. One eye developed malignant glaucoma 2 weeks following operation. Although this was controlled for a short time by mydriasis the eye has done badly. A further patient presented with acute glaucoma and was found to have a deeply-cupped atrophic disc and a best visual acuity of perception of light. Tension was difficult to control and trabeculectomy was performed. Malignant glaucoma developed at 6 weeks, was controlled for 2 weeks by mydriatics and then recurred. Perception of light had been lost and the eye was finally rendered pain-free by a retrobulbar injection of alcohol.

Visual acuity fell by more than two Snellen lines in four of the eyes in which the intraocular pressure was controlled by surgery alone, in two eyes because of the development of lens opacities and in two because of progression of field defects. Pre-existing lens opacities were seen to have progressed to a lesser extent in a further three eyes in this group. Two of the eyes not controlled by surgery alone also sustained a fall of visual acuity of over 2 Snellen lines, one because of malignant glaucoma and the other because of maturation of lens opacities. The visual acuity of the second eye to develop malignant glaucoma fell from perception of light to blindness.

Postoperative ocular hypotension of less than 10 mm.Hg occurred in seven eyes. In three it was transient, but one of these eyes went on to develop malignant glaucoma, as described above. In four eyes hypotension persisted at levels of 8, 8, 7, and 8 mm.Hg respectively. One of these eyes lost vision from macular changes, the others were not further damaged.

HAEMORRHAGIC GLAUCOMA

Thirteen eyes of thirteen patients were operated. The aetiology was diabetes mellitus in four eyes, central retinal vein thrombosis in eight, and uveitis in one. Pressure was maintained at 21 mm.Hg or below without medication in only four eyes, a further three were controlled with the addition of local medication, and six failed, all within a month of surgery. Only two eyes developed drainage blebs. Postoperative hyphaemata were very troublesome, occurring in eleven eyes and persisting for from 2 to 40 days (average 11.6). There was no loss of anterior chamber in this group.

SECONDARY GLAUCOMA

One perforating injury, three contusion injuries, and one eye with complicated cataract extraction were operated on. One was controlled by surgery alone, one other developed a bleb but needed Pilocarpine 4 per cent. four times a day to maintain a tension of 18 mm.Hg a third eye settled on gutt. Ad Pilo 4 per cent. four times a day postoperatively, and the other two eyes failed. There were two hyphaemata at the first dressing, and both cleared by the 3rd day. No loss of anterior chamber occurred. All the failures occurred within one month of surgery.

DEVELOPMENTAL GLAUCOMA

Two kuphthalmic eyes and one eye of a 34-year-old woman with juvenile glaucoma due to mesodermal dysgenesis of the anterior chamber make up this group. The two infants had

had repeated failed goniotomies and are now well controlled by trabeculectomy alone after 30 and 31 months. One of these suffered a flat anterior chamber for 3 days after surgery which re-formed spontaneously, and both have good drainage blebs.

The adult eye has been followed for 38 months; it is maintaining a good bleb but requires gutt. Pilocarpine 2 per cent. twice daily to keep the intraocular pressure at 15 mm.Hg. The eye suffered no complication and maintains the same visual acuity as before the operation.

Discussion

The results reported here suggest that when trabeculectomy fails it does so soon after operation, and almost always within one year of surgery. Thus a follow-up of 1 to 3 years should give a true picture of the success rate of the procedure in terms of control of intraocular pressure (Table V).

Table V Results (*per cent.*)

<i>Type of glaucoma</i>	<i>Results (per cent.)</i>		
	<i>Controlled by surgery alone</i>	<i>Controlled with additional medication</i>	<i>Failed</i>
Chronic simple	71	16	13
Chronic angle-closure	84	7.5	8.5
Primary adult glaucoma (total)	77	12	11
Haemorrhagic	31	23	46
Secondary	20	40	40
Developmental	66	33	0

PRIMARY GLAUCOMAS

In eyes suffering from primary adult glaucomas, intraocular pressure was maintained at or below 21 mm.Hg in 77 per cent. by surgery alone, and in a further 12 per cent. with additional local medication, a total of 89 per cent. In terms of control of intraocular pressure alone, these figures are similar to those for Elliott's trephine operation, iridencleisis, and Scheie's thermal sclerotomy procedure (Scheie, 1962; Graham, 1966).

However, an unacceptable fall in visual acuity occurred in thirteen eyes in which pressure was controlled (nine by surgery alone and four with additional local medication). Cataracts developed or progressed in seven eyes and field loss progressed to the point of failure of visual acuity in six. Since the aim of surgical intervention had not been achieved, and particularly since subsequent cataract extraction in three eyes led to failure of control of intraocular pressure, trabeculectomy must be considered to have failed in these thirteen eyes.

Therefore, the overall success rate of this procedure in eyes suffering from primary adult glaucomas, defined as control of intraocular pressure with maintenance of visual acuity for 1 to 3 years after operation, becomes 70 per cent. for trabeculectomy alone and 79 per cent. for trabeculectomy with and without additional postoperative local medication.

Early postoperative complications were infrequent. In 131 eyes suffering from primary glaucoma small hyphaemata occurred in sixteen eyes (12 per cent.) and flat anterior chambers were present at the first dressing in five (4 per cent.). Uneventful resolution occurred in all cases. Two conjunctival wounds required re-suturing.

Serious complications other than cataract developed in four eyes. Malignant glaucoma supervened in two eyes operated on for chronic angle-closure glaucoma. The two eyes of a

patient suffering from chronic simple glaucoma and severe rheumatoid arthritis developed small ciliary staphylomata over the operation sites. (A further patient, not included in this series because follow-up is less than 1 year at present, also developed a small area of scleral necrosis over the operation site. Despite this a bleb has formed and pressure is controlled. This patient also has severe rheumatoid arthritis).

Postoperative ocular hypotension was encountered in nineteen eyes (14.5 per cent.) but few sequelae were found which could be ascribed to this, only four eyes out of these nineteen suffering loss of vision: one from cataract, one from progressive field loss, one from malignant glaucoma, and one from macular degeneration with the loss of 2 Snellen lines of visual acuity. Twelve hypotensive eyes suffered from chronic simple glaucoma and seven had chronic angle-closure glaucoma. The relative frequency of this complication in chronic simple glaucoma is in accordance with the findings of Scheie (1959).

OTHER GLAUCOMAS

As with previously described filtration operations, trabeculectomy did not prove useful in the management of haemorrhagic glaucoma. This failure appeared to be related to haemorrhage at the time of surgery followed by repair which sealed off the potential drainage ostia. The same mechanism probably explains the failure of the operation to control the pressure in four out of five eyes suffering from glaucoma secondary to trauma.

Two buphthalmic eyes and one eye suffering from developmental glaucoma of late onset have done well, and trabeculectomy appears to be of use when goniotomy fails.

It has not proved possible to demonstrate any significant alteration in the success of the procedure in those eyes treated with repository steroid or local oxyphenbutazone in the immediate postoperative period.

Summary

Trabeculectomy proved to be an effective method of controlling intraocular pressure in eyes suffering from primary glaucoma. Complications were few and follow-up of 1 to 3 years suggested that late failure was rare. The procedure did not prove so useful in the management of secondary glaucoma.

When maintenance of central vision and control of intraocular pressure were considered as criteria of success, 79 per cent. of eyes with primary glaucoma did well.

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References

- CAIRNS, J. E. (1968) *Amer. J. Ophthalm.*, **66**, 673
 CHATTERJEE, S., and ANSARI, M. W. (1972) *Brit. J. Ophthalm.*, **56**, 783
 D'ERMO, F., and BONOMI, L. (1973) *Ophthalmologica (Basel)*, **166**, 311
 GRAHAM, M. V. (1966) *Trans. ophthalm. Soc. U.K.*, **86**, 223
 RIDGWAY, A. E. A., RUBINSTEIN, K., and SMITH, V. H. (1972) *Brit. J. Ophthalm.*, **56**, 511
 SCHEIE, H. (1959) *A.M.A. Arch. Ophthalm.*, **61**, 291
 ——— (1962) *Amer. J. Ophthalm.*, **53**, 571
 THYER, H. W., and WILSON, P. (1972) *Brit. J. Ophthalm.*, **56**, 37
 WATSON, P. G. (1969) *Trans. ophthalm. Soc. U.K.*, **89**, 523