

## Conjunctival Incisions for Trabeculectomy and Their Relationship to the Type of Bleb Formation—A Preliminary Study

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### Summary

The bleb which develops following trabeculectomy may be diffuse or cystic in nature. Cystic blebs can be complicated by infection, leakage of aqueous, astigmatism, and problems related to contact lens wear, whereas diffuse blebs are not associated with such problems. We report a preliminary prospective photographic evaluation of bleb formation following each of three types of conjunctival incision: (a) fornix based (b) straight limbus based and (c) curved limbus based. The vascular pattern and morphology of the drainage bleb formed was dependent upon the type of conjunctival incision made. The fornix based flap was found most likely to give rise to a diffuse bleb with a normal vascular pattern.

Trabeculectomy has become the commonest surgical procedure for the treatment of glaucoma. It was first described by Cairns<sup>1</sup> and subsequently by Watson<sup>2</sup> who gave a modified description. In both types of procedure, a limbus based flap was described. In Cairns' original description, a bleb developed in 7 out of 17 cases whereas in Watson's description, a bleb developed in 25 out of 44 cases.

In one series, Luntz<sup>3</sup> reported the results of trabeculectomy on 83 eyes with open angle glaucoma between 1967 and 1979. He preferred the fornix-based conjunctival flap to the limbus-based flap in view of the problems associated with the surgical procedure for limbus-based flaps. These included:

- (a) Poorer visualisation and exposure of the area for surgical treatment,
- (b) Greater chance of button-holing the conjunctival flap.

Also, post-operatively, the risk of a flat or shallow anterior chamber, the more anteriorly placed conjunctival bleb and the higher risk of a thin flap overhanging the cornea were considered to present problems. All his successfully operated eyes had subconjunctival drainage blebs which were diffuse in nature.

Shuster *et al.*<sup>4</sup> compared limbus and fornix-based conjunctival flaps in a randomised, prospective study on 37 phakic eyes with primary open angle glaucoma and found that filtration surgery was equally successful in both groups independent of the type of conjunctival flap. The filtration bleb was similar for both types of conjunctival flap, a diffuse bleb with filtration being posterior in all cases. They did not, however, comment on the pattern of healing of the conjunctiva.

In a recent series, Watson<sup>5</sup> found a 21 per cent rate of cystic bleb formation with fornix

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based conjunctival flaps as opposed to a 34.5 per cent rate with limbus based flaps. The long term efficacy of trabeculectomy has been proven by various studies including those carried out by Ridgway,<sup>6</sup> Schwartz and Anderson,<sup>7</sup> Wilson,<sup>8</sup> Mills,<sup>9</sup> Watson and Barnett,<sup>10</sup> and its effectiveness seems to be due to fistula formation into a subconjunctival drainage bleb.<sup>9-12</sup> The problems of cystic blebs include infection, which may lead on to endophthalmitis, leakage of aqueous, astigmatism and problems related to contact lens wear.<sup>5,13,14</sup>

Scant attention has been paid to the method of dissection, place of cutting and method of suturing of the conjunctiva and Tenon's capsule. We have conducted a sequential photographic study of trabeculectomy bleb development with three types of conjunctival incision in order:

- (i) to determine the factors which predispose to cystic and diffuse bleb formation,
- (ii) to ascertain the pattern of revascularisation and
- (iii) to compare the initial therapeutic efficacy of each of these procedures.

#### Patients and Methods

Patients ranging in age between 42 and 88 years, for whom trabeculectomy was deemed necessary for the treatment of open angle or chronic closed angle glaucoma were recruited to the study.

Thirty patients were randomly allocated into 3 groups of 10. For each group of 10, a different conjunctiva/Tenon's capsule incision was made as illustrated in Figs. 1, 2 and 3. As can be seen, for the fornix based flap, no conjunctival vessels were divided; for the straight limbus based flap, some of the conjunctival vessels supplying the flap were divided, whereas the curved conjunctival incision (limbus to limbus flap) entailed cutting all the vasculature to the flap.

In all three methods, both conjunctiva and Tenon's capsule were cut together by holding the spring scissors perpendicular to the point of incision and incising the conjunctiva first, then holding the Tenon's capsule with a pair of plain forceps and incising. The Tenon's capsule was undermined before cutting both conjunctiva and Tenon's capsule together in subsequent incisions. The superficial scleral flap was the same in all 3 groups, and comprised a 5×6 mm limbus-based flap extending just into cornea. The deep scleral block 3×2 mm, extended posteriorly on to the ciliary body and

anteriorly into the cornea, thereby containing cornea, trabecular meshwork, scleral spur, the canal of Schlemm and deep sclera. A peripheral iridectomy was performed in all cases and the superficial scleral flap was sutured into place at the 2 corners with 8/0 virgin silk. The conjunctiva was also sutured with 8/0 virgin silk, two interrupted stitches were used for the fornix based and three for the limbus based flaps, making sure Tenon's capsule was included in the suture line.



Fig. 1. Diagram illustrating the position of the conjunctival incision for the fornix based flap.

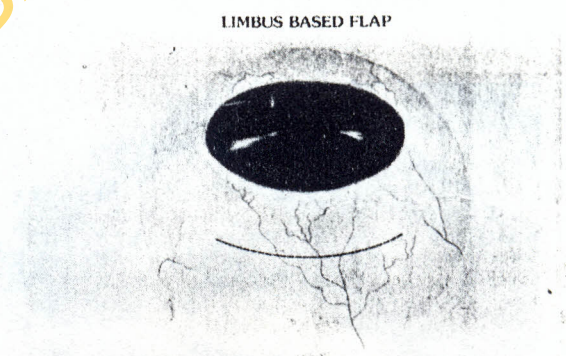


Fig. 2. Diagram illustrating the position of the straight conjunctival incision for a limbus based flap.

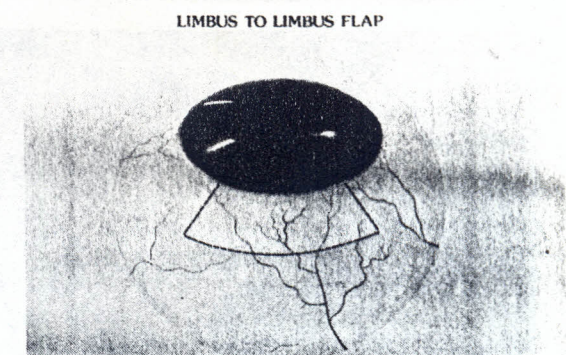


Fig. 3. Diagram illustrating the position of the curved conjunctival incision for a limbus based flap.

The results were documented for each patient according to the protocol outlined in Table I. On discharge from hospital each patient was given all the appointments required for the procedures listed in Table I to be carried out.

### Results

Table II lists the numbers of patients who developed cystic and diffuse blebs in relation to the type of conjunctival incision. In most cases the fornix based flap resulted in a diffuse bleb however, in two, cystic blebs developed. In one of these, the conjunctival scar was gradually 'dragged' across to overly the scleral incision. This was followed by the development of a small bleb which ballooned out through the scar tissue. In the second case, two small cysts appeared at the limbus near the original radial incision. In no case did the conjunctival flap itself subsequently become cystic in nature. Figures 4a-d, illustrate the evolution of a diffuse bleb which typified those which occurred following the fornix based conjunctival flap.

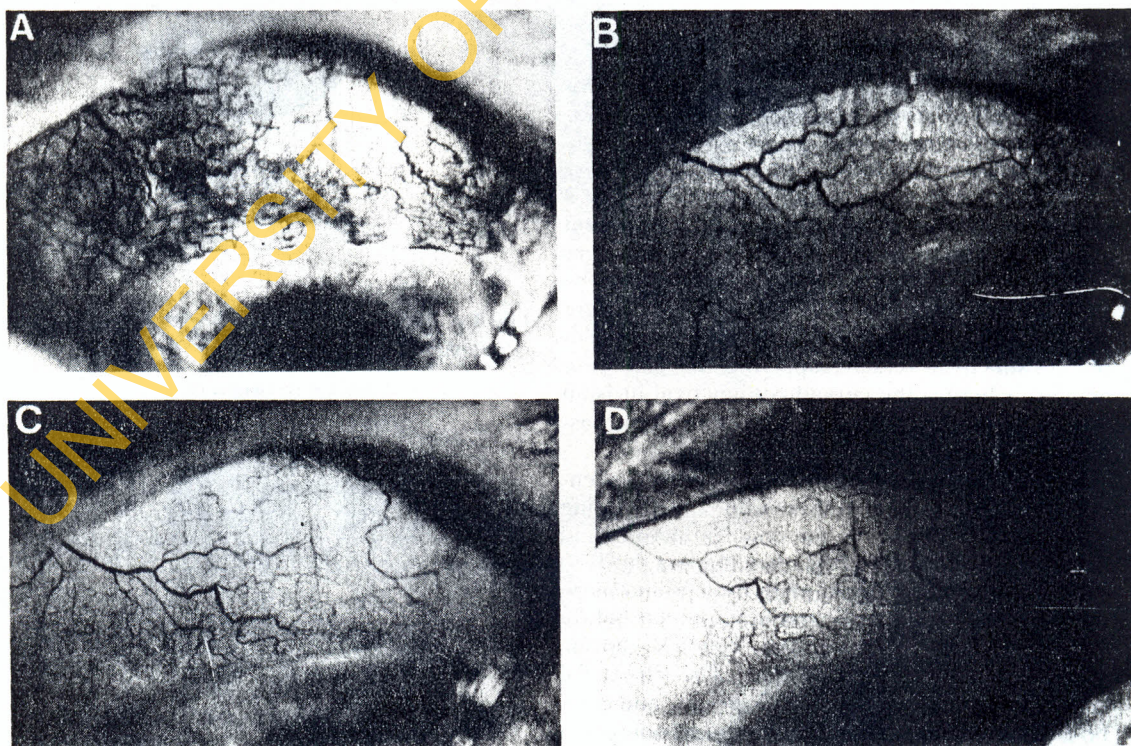
**Table I** Nature and timing of the investigations performed for each patient

Procedure	Time post-operatively
Photography of the conjunctival bleb and measurement of intraocular pressure	2 days, 2 weeks, 6 weeks, 3 months, 6 months
Visual field assessment	6 months
Gonioscopy	6 months
Siedel test	6 months

**Table II** Type of conjunctival incision made, and the form of subsequent conjunctival bleb formation

Conjunctival incision	Type of Bleb	
	Cystic	Diffuse
Fornix based	2	8
Straight limbus based	5	5
Curved limbus based	4	0

With regard to the limbus based flaps, cystic blebs and diffuse blebs were almost equal in incidence for each conjunctival incision.



**Fig. 4a-d.** These photographs illustrate the features of evolution of a diffuse bleb following a fornix based conjunctival flap for trabeculectomy. (A 2 days; B 6 days; C 3 months; D 6 months following surgery).

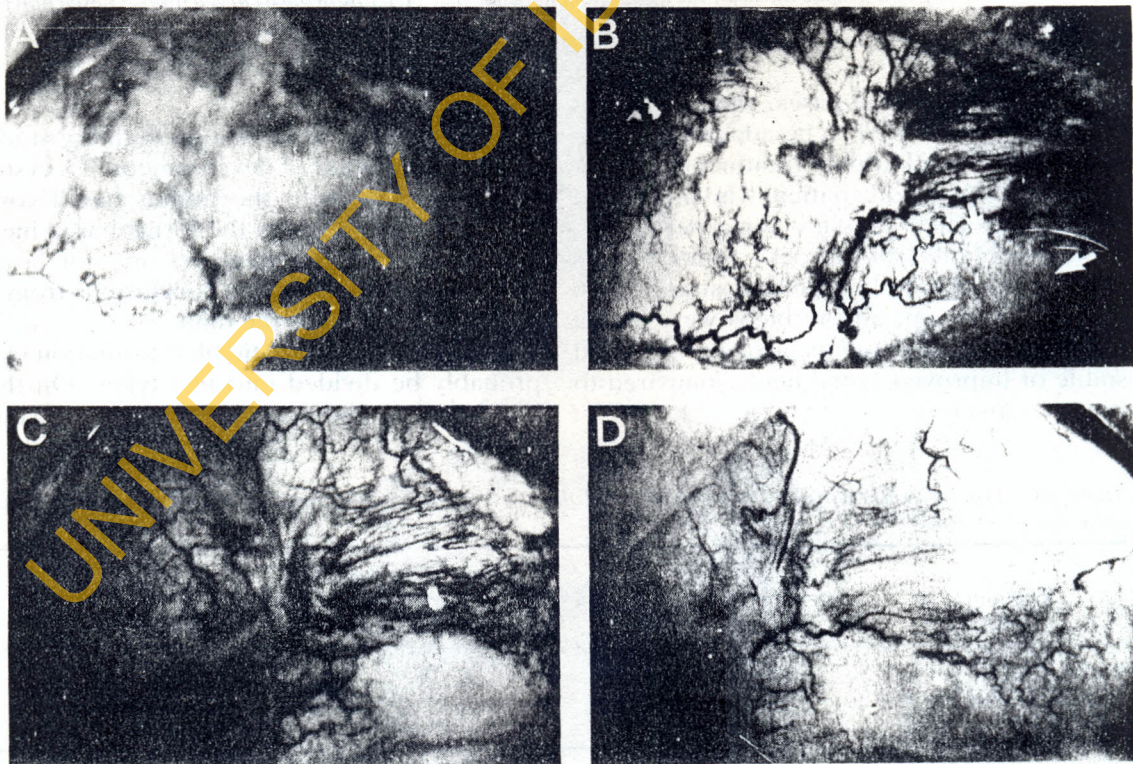
Figures 5a-d illustrate the evolution of a typical cystic bleb which followed a straight conjunctival incision. Part of the conjunctival flap is initially avascular (arrowheads). The scar tissue which forms at the site of the conjunctival incision contracts and approximates towards the margins of the scleral flap. Eventually, the original avascular area becomes cystic despite opening of collateral vasculature and the development of new vessels across the scar (which were not observed in the early post operative period, but were confirmed by later photography) which have grown across the conjunctival scar, but have not revascularised the whole area.

Figures 6a-d provide illustrations of the way in which a diffuse bleb developed following a curved conjunctival incision. This shows a pattern in which the whole flap has been revascularised by new vessels which have grown across the original incision and dilated collateral vasculature adjacent to the terminal portion of the incision.

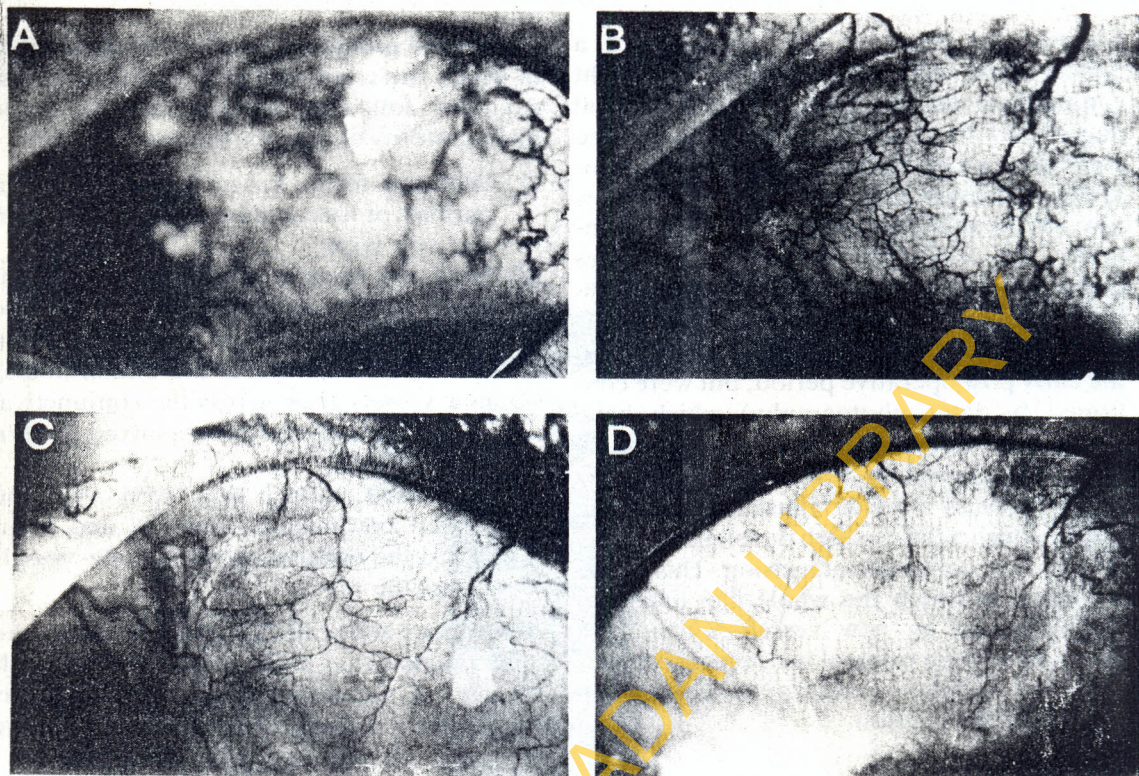
Table III provides an analysis of the manner in which the conjunctival blebs became vascularised following trabeculectomy. Three main patterns of vascularisation were seen:

- (1) With the fornix based flap, the original pattern of vasculature was sustained in the long term.
- (2) With the straight conjunctival incision, the original vasculature initially became markedly dilated. With time, the dilation of the original vasculature diminished as new vessels grew across the conjunctival scar. This is described as a mixed pattern in Table III.
- (3) The third pattern was seen with the curved conjunctival incision and comprised the uniform growth of new vessels across the scar.

In the cases where the vessels grew across the flap completely, a diffuse bleb was formed, whereas in the cases where the growth was rudimentary a cystic bleb developed in the



**Fig. 5a-d.** These photographs illustrate the development of a cystic bleb following a straight limbus based flap for trabeculectomy. (A 2 days; B 2 weeks; C 3 months; D 6 months following surgery).



**Fig. 6a-d.** These photographs illustrate the development of a diffuse bleb following a curved limbus based flap for trabeculectomy (A 2 weeks; B 6 weeks; C 3 months; D 6 months following surgery).

avascular area. In all cases, the intraocular pressure was deemed to be adequately 'controlled' and no additional treatment was prescribed except for one patient who developed raised intraocular pressure for a period following a blunt (shuttlecock) injury to his operated eye 2 months following surgery. At 6 months follow up, all the blebs were Siedel negative and all patients, except one, had stable or improved visual fields compared to pre-operatively.

#### Discussion.

It would appear from this preliminary study that the likelihood of development of a cystic bleb is greater with the limbus based conjunctival flap than with the fornix based incision. However, the numbers are not large enough to draw definitive conclusions from a statistical analysis of the data.

The aetiology of cystic bleb formation can probably be divided into two types. On the one hand, in those cases in which the con-

**Table III** Type of conjunctival incision made, and the subsequent vascular pattern overlying the bleb which subsequently formed

Conjunctival incision	Pattern of vascularisation		
	Original pattern	New vessels only	Mixed pattern
Fornix based	1C:8D*	1C†	0
Straight limbus based	0	2C:3D	3C:2D
Curved limbus based	0	4C:6D	0

\*C = number with cystic blebs; D = number with diffuse blebs.

†Single large vessel across radial incision site.

conjunctival vessels are severed in the limbus based flap, the relative ischaemia thereby engendered appears to predispose to the development of an avascular area of conjunctiva which may either revascularise or ultimately become cystic. On the other hand, in some cases, the contraction of the scar tissue which follows the conjunctival incision may bring the conjunctival scar to overly the original scleral incision. The subsequent development of the cystic bleb in this situation appears to result from the incorporation of avascular scar tissue into the bleb. This may be avoided by making the conjunctival incision far from the scleral incision. Shuster *et al.* found no difference in the appearance of the conjunctival bleb following fornix or limbus-based conjunctival incision.<sup>4</sup> This is at variance with the results we have obtained and may reflect differences in surgical technique. Alternatively it is possible that longer term follow-up could have revealed the late development of cystic blebs.

Concern about leakage of aqueous, secondary hypotony and a 'flat' anterior chamber has dissuaded many practitioners from performing a fornix based flap for trabeculectomy. In none of our cases were these complications seen. The method used to avoid leakage of aqueous comprised

- (a) slight hooding of the conjunctival flap over the cornea at the end of the surgical procedure,
- (b) sewing the conjunctival flap to the episclera (thus preventing subsequent retraction of the conjunctival hood) and
- (c) not extending the marginal cuts of the scleral flap too far into the cornea.

The results which we have obtained from this initial study indicate that there is no difference in the degree of control of intraocular pressure with a cystic or diffuse bleb, and would suggest that cystic bleb formation is

less likely to follow a fornix based conjunctival flap than a limbus based incision. Further studies are required in order to define the best position and type of conjunctival incision and suture materials, which will give rise to long term control of glaucoma with the lowest complication rate.

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