POLYTHENE TUBES IN CANALICULUS SURGERY*

BY

T. P. GRIFFITH†

*From the Corneo-Plastic Unit and Regional Eye Bank, Queen Victoria Hospital,
East Grinstead, Sussex*

CANALICULUS obstruction remains a difficult problem, although obstruction in the lacrimal sac or duct is now curable in 95 per cent. of cases by the procedure for dacryocystorhinostomy used in this Unit (Rycroft, 1951). This success rate indicates that the problem of main duct obstruction may be regarded as nearly solved, but this is not the case with canaliculus obstruction.

Failure often follows primary repair of a clean incised canaliculus injury and even more frequently follows the treatment of canaliculus obstruction due to infection, trauma including repeated probings, irrigations, and middle-third facial fractures—especially where there has been displacement of the bone fragments. The result of long periods of different forms of treatment has often been a troublesome watery eye and recurrent infections.

Witness to the difficulty of treatment is the multiplicity of methods that have been devised to treat or bypass the block—canthocystostomy, canthorhinostomy, conjunctivorhinostomy, conjunctivodacryocystostomy (Stallard's operation), transposition of upper to lower canaliculus, canaliculoplasty with lacrimal sac flap (Jones, 1954), or with conjunctival flap, resection of a stricture, and various methods of threading nylon strands through the canaliculi (Stallard, 1958).

Canaliculus obstruction is thus a special problem, and in an effort to solve it the use of polythene tubes has been developed in this Unit over the last 5 years. Polythene tubing was used as it is flexible, well tolerated by the tissues, and available in a size corresponding with that of the canalicular lumen.‡

In the period January, 1959, to February, 1962, polythene tubes were used in the treatment of canaliculus obstruction in 47 operations (38 patients).

Pre-operative Investigations

The site of obstruction was diagnosed by:

(a) Trying to pass a fine cannula into the sac *via* both canaliculi in turn and finding either that there was a complete block or that the cannula was firmly gripped by an area of stenosis.

(b) Irrigation of both canaliculi in turn with normal saline to demonstrate that no fluid passed through the opposite punctum, lacrimal sac, or nasal passage, or that fluid did flow but only with pressure.

(c) Dacryocystography (Fig. 1, overleaf).

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† Present appointment: Consultant surgeon, West Cumberland Hospital Group.

‡ No. 1 polythene tube for intravenous use, Messrs. Allen and Hanbury.

FIG. 1.—Dacryocystogram, showing ampullary block. The lipiodol has filled only the ampulla and canaliculi.

FIG. 2.—Sites of possible canaliculus obstruction.

Type and Site of Block

Types

- (1) Partial; patency is present only on syringing with pressure.
- (2) Complete; no patency is present even on syringing with pressure.

Sites (Fig. 2)

- (1) Proximal, in the lateral half of the canaliculus.
- (2) Distal, in the medial half.
- (3) Ampullary, at the junction of both canaliculi.
- (4) Total, when the entire length of the canaliculus is affected.

Aetiology

The causes include injury, either directly to the canaliculi or as part of more extensive injuries such as middle-third facial fractures, repeated probings and syringings, burns by chemicals or heat, bacterial infections including recurrent abscesses, fungus infections such as *Streptothrix*, infectious fevers such as chickenpox, pemphigus, and ichthyosis congenita. In over 50 per cent. of cases, however, no definite cause was found.

Technique

General anaesthesia, though not essential, is usually easier for the patient and the surgeon, especially if effective low pressure anaesthesia is available, with a systolic pressure maintained at 60-65 mm. Hg during the operation. When this is obtained the operation can be practically bloodless and is incomparably easier than when every second instrument used is either a swab or a sucker. The procedure at this Unit is intubation with the aid of scoline after induction with pentothal (thiopentone)

sodium). Hypotension is induced by injection of a ganglion-blocking agent such as Ansolysen (pentolinium tartrate). In the theatre the table is tilted up to 45°. Anaesthesia and hypotension are maintained by controlled respiration using a nitrous oxide and oxygen mixture with the addition where necessary of fluothane (Halothan). If the hypotension is still inadequate, intermittent injections of Arfonad (Trimetaphan camphorsulphonate) are given through a Gordh needle.

Any or all of these procedures for low pressure anaesthesia may not be used in cases considered unsuitable by the anaesthetist.

The Dupuy-Dutemps modification of Toti's dacryocystorhinostomy is the basic operation used. The course of the angular vein is marked with gentian violet, and $\frac{1}{4}$ inch above this line a straight incision is made down to bone, starting just above the level of the medial palpebral ligament. The periosteum is elevated until the lacrimal fossa is exposed. If possible the level of the common canalicular opening is determined by passing a probe *via* the upper or lower canaliculus and noting where the nasal wall of the sac is indented. At this level (or an approximation if the canalicular block is complete) a disc of nasal bone is hand-trephined, intranasal transillumination with Rycroft's rhinostomy lamp having given a guide to bone thickness and to the presence of any anteriorly-placed ethmoid cells.

The bony ostium is enlarged, avoiding damage to the nasal mucosa, and any ethmoid cells that might cause obstruction to drainage are removed. The anterior and posterior sac and nasal mucosal flaps are fashioned with the aid of Werb's scissors. The posterior flaps are sutured together where possible, using modified cleft-palate $\frac{3}{8}$ -circle needles (Rycroft, 1951).

A fine probe is passed from the punctum into the lacrimal sac through the area of stenosis or block. Where this cannot be done with the probe alone the end of the probe is exposed by cutting down onto it from inside the sac.

Where no punctum is found or there is a complete block 1-3 mm. from the punctum, the medial end of the canaliculus is identified in the sac wall and a probe is passed in the reverse direction cutting down from the lid margin where necessary.

The bodkin* and nylon thread is then passed along this track, the bodkin having been curved as necessary to enable it to be brought out easily from the rhinostomy incision. The nylon which acts as a guide is threaded inside the No. 1 polythene tube for 2 to 3" and the end of the thread and tube are clamped together (Fig. 3). Traction on the bodkin end of the nylon thread enables the tube to be passed along the canaliculus into the sac.

FIG. 3.—Curve of bodkin. The nylon thread has been passed into the lumen of the polythene tube, and thread and tube clamped together.

* Bodkin with atraumatic nylon filament for rhinostomy, Messrs. C. W. Dixey.

This passage is aided by the following procedures:

(a) Previously dilating the punctum and canaliculus with a probe the size of the polythene tube;

(b) Using a polythene tube with a tapered end. This is achieved by pulling on a short section of the tube until breaking occurs and trimming the resulting taper until the lumen is just large enough to admit the nylon filament (Fig. 4);

(c) Lubricating the tube with ointment or liquid paraffin.

The other end of the polythene tube is passed through the other canaliculus in the same way. Both tube ends are then threaded into the rhinostomy opening and out through the nostril alongside the rubber catheter when this has been thought necessary to hold the sac flaps apart (Fig. 5).

FIG. 4.—Nylon thread in lumen of polythene tube, untapered (above) and tapered (below). The tapered tube is much more easily threaded through the canaliculus.

FIG. 5.—Curve of polythene tube resting on a contact lens (used routinely during rhinostomy operation to avoid damage to the cornea). The tubes are shown crossing the rubber catheter in the incision and emerging from the nostril.

The dacryocystorhinostomy is completed by suturing together first the anterior nasal and sac flaps and then the skin edges, both with interrupted sutures. The two polythene tube ends are pulled down until a satisfactorily small curve of tube connects the puncta without excessive distortion (Fig. 6, opposite). The two ends are threaded through a 5 to 10-mm. length of larger-bore tubing. This short length is slid over the two fine tubes until it rests just inside the nostril almost out of sight. The excess fine tube is cut off and the three ends secured together by the application of a dull red cautery (Fig. 7, opposite). The tubes are left *in situ* for up to 6 months.

FIG. 6.—Polythene tube passing from upper to lower punctum post-operatively. This is practically invisible when viewed from a distance of more than 12 in.

FIG. 7.—Joined ends of the tubes just seen in left nostril viewed from below.

In some cases the degree or type of canaliculus obstruction may make recurrent stenosis likely after fine tubes have been in place even for 6 months. In these cases the fine tubes can be replaced after 2 or 3 months by a larger tube*. The procedure is as follows: the fine tube between the puncta is cut and a nylon filament is threaded down each end until it reaches the nose; the procedure outlined above for the threading of the fine polythene tubing is then repeated using the larger size.

Illustrative Case Reports

Case 1, a man aged 50 years, had had watering of both eyes for 2 years with no known cause. Bilateral dacryocystorhinostomy in 1957 did not relieve the watering. The right lower canaliculus was stenosed at 5 mm. from the punctum; the upper canaliculus at 6 mm. The left lower canaliculus ended in a fistula at 1 mm.

Repetition dacryocystorhinostomies using polythene tubes were carried out in September, 1958, (left side) and April, 1959, (right side). The tubes were left in 4 months.

Complete freedom from watering was reported in March, 1962 (2½ to 3 years later).

Case 2, a man aged 52 years, had had dacryocystorhinostomy in March, 1956, for a watery right eye due to blocked lacrimal sac. Repetition dacryocystorhinostomy was carried out in May, 1956, for recurrence of obstruction, but a further obstruction occurred after 2 months of patency. Patency was re-established by a lacrimal exploration in January, 1957, but the obstruction recurred in spite of constant syringing. At this stage he was referred to this Unit.

Pre-operative investigation showing a block of both canaliculi at about 6 mm. Dacryocystorhinostomy with polythene tubes was carried out in October, 1958, and in March, 1962, nearly 3½ years later, complete freedom from watering was reported, and free patency to syringing of both canaliculi was found.

* No. 2 polythene tube for intravenous use, Messrs. Allen and Hanbury.

Results

Of the original 38 cases (47 operations) so far treated, review has been possible in 29 (35 operations). One case was successful only at the fourth operation, and three other patients have had two operations. The overall success ratio is 62 per cent., or taking into account first operations only 50 per cent. (Table).

TABLE
RESULTS OF POLYTHENE INTUBATION FOR CANALICULAR OBSTRUCTION IN
29 CASES, 1959-1962

Aetiology	No. of Cases	Results	
		Patent	Blocked
Idiopathic condition	17	12	5
Trauma—motoring accident	5	3	2
Trauma—non-motoring accident	2	1	1
Recurrent abscesses	2	1	1
Ulceration of canaliculus	1	1	—
Ichthyosis congenita	1	—	1
Pemphigus	1	—	1
Total—All Cases	29	18 (62 per cent.)	11 (38 per cent.)
Total—After Removal of Tubes	26	16 (61·5 per cent.)	10 (38·5 per cent.)

Eighteen patients have been under surveillance for up to 3½ years, and sixteen of these have had the tubes out for 6 months or more.

Discussion

Plastic tubes have been used in lacrimal surgery in the treatment of lower sac or duct blockage (Scott and Summerskill, 1949; Summerskill, 1952; Moron-Ruiz, 1952; Dejean, 1951; Malbrán, 1953; Loubere, 1955), and also as a means of ensuring that continuity of the canaliculus and a newly-made bony ostium is maintained (Bonaccolto, 1957). Henderson (1950) sutured a polythene tube into the length of only the lower canaliculus with a mattress suture through the tube, canaliculus, and skin. A temporary fistula occurred around the suture. Henderson (1953) reported five similar cases; cure of epiphora was achieved in three, but the tube pulled out in one and the punctum sealed over the lateral end of the tube in another. All these complications should be avoided by the technique described in this paper.

Henderson concluded that the operation was most successful when combined with dacryocystorhinostomy. Huggert (1959) has also concluded that polythene tubes leading into the nose *via* the upper and lower canaliculus and kept in place for 6 months give a very good chance of permanent patency. Since this technique does not seem to be widely known and our method has been evolved independently, it was felt justifiable to present this article in the hope that the results so obtained would become better known.

One difference is that Huggert's technique involved no dacryocystorhinostomy: the sac was opened and the two ends of the tube threaded down the naso-lacrimal duct. This would probably not be attempted where there was any evidence of naso-lacrimal duct obstruction. A dacryocystorhinostomy would be needed if an obstruction was shown in the sac or duct in a pre-operative dacryocystogram, or if a block was found at operation.

The need for dacryocystorhinostomy would only be in doubt where sac and duct patency was shown in a pre-operative dacryocystogram and confirmed by syringing and/or probing at operation. Neither of these necessarily implies physiological patency, and if this was found to be lacking post-operatively a dacryocystorhinostomy would be needed later. A further possibility is that trauma while the tubes were in place might lead to duct stenosis and necessitate subsequent dacryocystorhinostomy.

A few unnecessary dacryocystorhinostomies would be done if the technique described in this article were used in every case. It is felt, however, that the extreme rarity of serious complications to dacryocystorhinostomy and the avoidance of secondary operations fully justifies it as a routine part of the treatment of canalicular obstruction with polythene tubes.

Jones (1960) described a technique for the excision of a canalicular stenosis and for an end-to-side anastomosis of canaliculus and sac. This procedure, however, is time-consuming, taking up to 4 hours, and would probably be unsuitable for bad-risk cases and for cases of full-length or proximal canaliculus block.

Fibrosis and contracture are thought to be largely complete by the end of 6 months after a given operation, and it has been found that leaving the tubes in for 6 months leads to a higher rate of success. It is felt that the satisfactory cosmetic appearance which has now been made possible (Fig. 8) makes this

FIG. 8.—Satisfactory cosmetic result, with polythene tubes in place on left side.

long period of intubation a much more tolerable burden than the watery eye which requires perpetual wiping.

Where the operative probing has shown that the obstruction is small (e.g. a band of mucosa forming a valve at the junction of ampulla and sac), the obstruction can usually be divided and the tubes need to be retained for only about 4 to 8 weeks.

Summary

A method is described for the treatment of lacrimal canaliculus obstruction by the use of polythene tubes.

I should like to express my very grateful appreciation to Sir Benjamin Rycroft for his encouragement and help, and also to the other members of the Unit: Sister King, Dr. Werb, Dr. Mueller, and Dr. Ahmed, who have all contributed to the development of the present technique. I am grateful to Dr. Campbell for the dacryocystogram, and to Mr. Clementson, Director of the Photographic Department, and Dr. Mueller for their help in the preparation of the illustrations.

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