SURGERY OF EXTERNAL RHINOSTOMY OPERATIONS*

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AN eye which waters persistently from obstruction of lacrimal drainage is not only a social embarrassment but may well influence adversely the chances of livelihood, especially in outdoor occupations or in the handling of food. Since lacrimal obstruction from trauma occurs so often nowadays in young people the cure is important and the remedy lies within the surgical province of the ophthalmic surgeon.

During the past 25 years British ophthalmic surgeons have seen great inroads on their ancient orbital territory. Neuro-surgeons invade from the side and above, rhinologists infiltrate through the medial wall, and plastic surgeons enfilade the front. By fashion of training and by lack of opportunity, the ophthalmic surgeon has had to retreat behind the ramparts of Tenon's capsule, but in the surgical treatment of epiphora and other lesions of the orbital adnexa it is surely time for him to emerge, and to re-occupy his former province both by the expansion of his teaching and by the improvement of his surgical technique.

This paper seeks to indicate the principles and details of technique which have proved useful in over 150 rhinostomies of various types and to offer ideas of simplification for general use.

PRELIMINARY INVESTIGATION

After the diagnosis of lacrimal block has been established the opinion of a rhinologist is always sought. A report is obtained on the local conditions of the middle and inferior meatus such as the presence of nasal polypi or hypertrophy of the anterior end of the middle turbinate bone. Occasionally a marked deviation of the nasal septum first requires correction before rhinostomy can succeed, and adhesions of the septum to the lateral wall of the nose are noted in traumatic cases. In one instance unilateral naso-lacrimal duct obstruction was the first sign of malignant disease of the antrum.

A general radiological examination of the skull is also made in every case to determine bony abnormalities, translucency of the sinuses, and the presence of an anterior ethmoidal cell which may extend downwards behind the lacrimal bone and influence the depth and size of mucous membrane flaps at subsequent operation.

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FIG. 1.—Upper naso-lacrimal block, caused by trauma. Left dacryocystogram showing rupture of the main lacrimal duct and lateral dislocation of the atonic sac, due to fracture of left malar-maxillary complex in a miner (high-level block). There is no epiphora two years after cysto-rhinostomy.

FIG. 2.—Lower naso-lacrimal block, caused by chronic infection. Right neo-hydril dacryocystogram showing an unusual site for lacrimal obstruction at the nasal opening of the main duct at the root of the inferior turbinate bone (low-level block). Note outline of lashes and canaliculi. Nasal examination showed impaction of the inferior turbinate bone against the lateral wall of the nose. Epiphora was cured by a single probing and disimpaction of the turbinate bone.

Routine dacryo-cystograms with Neo-Hydril are taken to show the level of the obstruction, the position and size of the canaliculi and sac, and the presence of sac loculation (Figs 1 and 2, above, and 3, overleaf).

FIG. 3.—Rupture of right naso-lacrimal duct, caused by trauma. Fracture of right middle third maxillo-malar complex has diverted the naso-lacrimal duct to open into the right antrum.

ANAESTHESIA

For anastomosis operations in traumatic cases where there is much cicatrization general anaesthesia is essential; it is combined with local infiltration of the tissues with novocaine and adrenaline to assist haemostasis. Local anaesthesia alone is not usually effective in this type of case. Intra-tracheal anaesthesia with pharyngeal pack is routine. The use of the new methonium compounds to depress the blood pressure during general anaesthesia greatly facilitates operations on the lacrimal area as bleeding is thus almost eliminated (Enderby, 1950).

For non-traumatic obstruction due to chronic nasal infection, local infiltration together with nose packs is generally sufficient.

In all rhinostomy operations the nose is previously prepared by 10 per cent. cocaine spray followed by adrenaline pack; infiltration of the nasal mucosa in front of the anterior end of the middle turbinate bone separates the mucosa from the bone and avoids later damage.

In addition to the special surgical instruments to be described, a sucker and a concentrated source of external illumination by spot lamp are essential.

TECHNIQUE

(1) **DACRYO-CYSTEOTOMY.**—Except in patients over 60 years of age, this operation should now be relegated to history for it has no place in the modern treatment of obstructive epiphora. It has always been illogical, and it has been able to persist too long because it is easy to do and is without much risk. Moreover, the training of ophthalmic surgeons in the past has not seriously included anastomosis operations with the nose. Dacryo-cystectomy eliminates a suppurating sac, but it does not cure epiphora and is at best a makeshift remedy, having no physiological basis. When the lacrimal sac is excised after the failure of repeated probing in infantile obstruction, insult is piled on injury: excision of the sac for obstruction is a procedure which should never be carried out in young people, but should be reserved for the elderly patient suffering from mucocele or pyocele and living mainly indoors near the fireside.

(2) **DACRYO-ADENECTOMY.**—The results of this operation are so inconsistent that it must be considered unreliable as a serious method of treatment for obstructive epiphora. Occasional successes have been reported, as also for Jamieson's method of sub-conjunctival section of the ductules, but most authorities agree that the results are so unpredictable that the operation should only be employed as a last resort. My practice has been to remove most of the lacrimal gland only when all other anastomotic measures have failed, as in cases where there has been intense fibrosis following wide bony trauma or burns. In such cases, absence of drainage and an irritable conjunctiva have kept the eye moist and no trouble from keratitis sicca has been encountered. Provided there is adequate lid coverage the risk of a dry eye after dacryo-adenectomy has probably been exaggerated. The best approach to the gland is through the skin, placing the incision in the fold of the upper lid, whereby excellent exposure to the upper and outer quadrant of the orbit is obtained.

(3) **LACRIMAL PROBE.**—Treatment by probes must be mentioned.

(a) *Infants.*—To pass a metal probe down the tiny tear duct of an infant should be considered as a serious procedure on which the comfort of the child's future life may depend. Probing is not justified before the age of 6 months and not even then if there is a report of progressive improvement of the epiphora. Most of these congenital cases clear up with the aid of persistent digital pressure over the lacrimal sac. The risk of damage to punctum or bone is considerable and probing demands the utmost care, using a well-oiled dilator followed by a greased No. 0. lacrimal probe under complete general anaesthesia.

(b) *Adults.*—The repeated use of probes in adults does not ensure permanent relief from epiphora. The use of the probe once is occasionally justified when obstruction is found to be at the lower third of the naso-lacrimal duct, where perhaps a mucous fold is obstructing the outlet in the inferior meatus (Fig. 2). These cases, however, are rare, and it is preferable to rely on pressure syringing with the upper canaliculus closed up.

(4) **DACRYO-CYSTOSTOMY.**—Experienced surgeons who practise this operation in many countries report 80 per cent. cure of epiphora. At the Plastic Unit at East Grinstead the method of Dupuy-Dutemps is preferred: the essential feature of this method is the accurate mobilization and suture of anterior and posterior flaps constructed from nasal and lacrimal-sac mucosa. The details of technique to be described are applicable to all anastomosis operations.

Exposure of Lacrimal Fossa.—The incision lies in a natural crease and is 3 cm. long: it is centred over the internal tarsal ligament, crossing it 3 mm. internal to the inner canthus. Beginners tend to place their incision too far in front, with the idea of reaching the bone on the medial side clear of the lacrimal sac. Such an incision does not give the best approach to the bony fossa and may involve large blood vessels with resultant unnecessary bleeding. In cases of obstruction due to simple catarrh, these large vessels are previously marked on the skin and are always avoided, but in traumatic cases with the displacement of tissues this is not always possible. A suitable knife for the incision is the Gillette Blade D: this blade is exquisitely sharp and has a heel which avoids rucking of the skin and an ugly scar. The approach to the sac should be regarded as from the side rather than from an antero-posterior direction.

The edges of the incision are lightly undermined so as to allow wide rake retraction. Rollier rakes are preferred to fixed retractors because they allow easier manipulation of a probe in the inferior canaliculus, and different parts of the incision can be retracted to different extents. They also have a definite value for local pressure haemostasis.

Mobilization of Lacrimal Sac.—The next stage is the mobilization of the sac. The tarsal ligament is the landmark for the sac; it is defined and the orbicularis is the split in the line of the fibres to the whole length of the incision, taking care not to go too deeply. The medial end of the ligament is followed to where it fans out over the bone and there it is cleanly divided. The important plane of separation between sac and bone is thus reached; by traction on the ligament the lacrimal sac can be peeled off the bone and dislocated laterally. This is conveniently done by the Rollier rugine which is reasonably sharp and is kept close to the bone. The bone of the lacrimal fossa is next meticulously cleaned, especially down to the bony duct; above the tarsal ligament the bone is cleaned as far as the fundus of the sac but there is no need to define it. The lower half of the sac and the naso-lacrimal duct should be well defined and complete haemostasis ensured.

Rhinostomy Lamp.—At this stage the nasal pack is removed and the Rycroft rhinostomy lamp is passed into position. This lamp consists of a small laryngoscope bulb mounted on a stainless steel column 12 in. long. It is connected to an ophthalmoscope base and battery and is wholly sterilizable.

The lamp is passed along the vestibule of the nose keeping close to the septum until the patch of illumination clearly transilluminates the lacrimal fossa. Inspection will then show dehiscences of bony structure and the exact location for the site of bone perforation. If the illumination is dull the presence of an anterior ethmoidal cell is suspected. Deep bleeding points are also detectable and can be easily picked up. If the bridge of the nose is high and the wound deep, the lamp gives useful illumination in the depths of the cavity. This lamp, which has been in use for over three years in the Plastic Unit and has not had to be modified, is also used for preliminary general inspection of the nose. When the bony fossa has been accurately cleaned with sac and ligament well retracted behind a rake, the bony fenestrum can next be made.

Bone Section.—For many years a hammer and chisel have been used or simple fracture has been performed where the lacrimal bone was very thin. By these methods it was not always possible to avoid damage to nasal mucosa and they have been discarded in favour of the use of the lacrimal hand trephine* (Fig. 4, opposite). Two types are used; one with a centre pin and coarse teeth for the initial groove of the bone, and a second type without a centre pin and with fine teeth to complete the section. The diameter of the trephine is 9 mm.; it is made of stainless steel and all in one piece for ease of sterilization.

The site of the bone opening is important, and the centre pin is engaged at the lower and posterior part of the lacrimal fossa close to the commencement of the naso-lacrimal duct; the corresponding nasal opening then falls just anterior to and below the end of the middle turbinate bone.

The centre pin is just long enough to penetrate bone without damage to mucosa, and once it is fixed the trephine is gently and firmly rotated slowly so that the teeth begin to bite easily. Care is taken to put the main pressure on the anterior edge where the thick bone of the nasal process of the maxilla has to be cut. With practice it

* For those who prefer electrical trephines there is the original mode; of Arruga. Such an instrument is difficult to procure in Great Britain, but at the suggestion of Mr. Ivor Lloyd, Messrs. Down Bros have constructed a similar instrument.

FIG. 4.—Rycroft lacrimal hand trephine (modified from Arruga, manufactured by Messrs. Allen and Hanbury).

becomes simple to cut a clean circular disk of bone and to lever it out in one piece. Transillumination by the rhinostomy lamp is a great help at this stage, and even in the hands of a novice serious damage to the nasal mucosa is rare. This was always a problem when the hammer and chisel were used. Traquair has designed an elevator which is very suitable for sweeping the nasal mucosa from the bone. Previous intra-nasal infiltration with novocaine-adrenaline assists this manoeuvre. The mucosa is then gently pushed towards the nose to make room for the punch.

The bony opening is enlarged downwards and backwards until it measures about $\frac{3}{4}$ in. long by $\frac{1}{2}$ in. wide. The Citelli type of punch is preferred: this has two fixed female cutting edges which allow enclosure of the bony fragments when cut off. Only one punch with upturned cutting edges is used. A sharp Nettleship dilator dislodges the bony fragments from the end of the punch. Such a punch should have long firm shanks and should always be sharp. If the shanks are short the hand obscures a view of the biting end in action, and if they are not rigid they tend to whip when the punch is twisted to remove bony fragments. The manoeuvre which cuts the bone commences with firm pressure and terminates by a twist to free the bony fragments. Heavy lever action is dangerous and means the punch is blunt.

If an anterior ethmoidal cell is encountered at this stage it is easily seen by the aid of the rhinostomy lamp and is nibbled away into the nose. The only difficulty then is that the nasal mucosa lies at greater depth and mobilization of posterior flaps becomes rather more difficult.

When the bony opening has been enlarged to suitable size and when the edges have been trimmed, the nasal mucosa, blanched by adrenaline is carefully inspected for condition and adventitious cuts. The rhinostomy lamp pushes it outwards into the wound for ease of inspection. If the mucosa is soft and boggy, an attempt at flap suture is worthless as stitches always cut out. In such cases it is preferable to employ a large anterior flap constructed entirely from the lacrimal sac. The posterior edge of the bony incision in such a case is then trimmed well back and cleared of mucosa. The principle of a single large flap is also used elsewhere in plastic surgery for the formation of mucous membrane tubes as in the urethra reconstruction.

Attention is next paid to the lacrimal sac and a Number 0 lacrimal probe is passed into it along the inferior canaliculus. Students should always be impressed that the utmost care is essential to avoid damage to the inferior punctum in these rhinostomy procedures. Punctum damage is seen after probe trauma on these occasions, and the

result of an excellent anastomosis operation may well be impaired by a damaged stenosed canaliculus or everted punctum.

The probe is gently pushed medially into the sac until the medial wall is tented. Plastic hooks are placed in the sac above and below, so that the sac wall is firmly stretched. The medial wall of the sac is opened with a Gillette knife over the probe, which then emerges and is moved gently up and down to enlarge the opening. One blade of a pair of round-end scissors is inserted into the sac opening making a single clean straight cut below and above. The interior of the sac is identified by the rugose mucosa of blue-grey colour.

If the sac is of the large patulous type, it is a simple procedure to fashion an anterior and a posterior flap. If the sac is small and fibrotic the flaps are extended by lateral dissection to include fascia and deep fibres of the orbicularis.

The flaps from nasal mucosa are formed by an incision over the rhinostomy lamp in a similar manner and completed in the same way with scissors. It is an advantage to construct the posterior anastomosis mainly of nasal mucosa and the anterior anastomosis mainly from sac. Approach is thereby easier and the suture lines do not lie exactly opposite each other. If the nasal flaps are tight, more bone must be nibbled away and more mucosa mobilized. It is absolutely essential that there should be easy apposition of flap edges and no tension on the suture line.

Suture of Flaps.—This can be a difficult procedure unless a proper needle is employed. Such a needle, suitable for use in a deep cavity, has been made for me by Messrs. A. W. Showell of Redditch. This is a small stout needle with 5/6 circle curve and with the cutting edge on the inside of the curve. It is similar to the Denis Browne cleft-palate needle but is smaller so as to be adapted to lacrimal needs (Fig. 5). Needles of this type fixed on a handle have been discarded, as after use the needle point becomes blunt and the hole rusts. Needles with a wide curve catch in the edges of the wound and cannot be easily passed through the mucosa. For easy work a needle with such a full curve is desirable, and it is inserted by wrist movement alone. No. 0 braided black silk is used. The next step is to place two or three sutures in the posterior flaps. If the mucosa is worth suturing the stitches will not pull out. When the posterior flaps are sutured, a narrow rubber tube (Jaques No. 3 catheter) is pulled down into the nose by a pair of narrow straight Spencer-Wells forceps and fixed in position by a single catgut stitch. The upper end of the tube lies for a week between the flaps and ensures that anterior and posterior flaps do not stick to each other; it also prevents the organization of blood clot in the bony opening. The anterior flaps are next sutured together over the tube and the orbicularis is neatly closed in layers with interrupted catgut sutures, the transverse tarsal ligament being fixed in position again. The wound is dusted with penicillin powder and interrupted sutures are used to close the skin; a continuous intra-cuticular stitch does not fit nicely in a curved incision and occasionally it is necessary to release a stitch for drainage if there has been considerable infection of the sac and contamination of the incision. A narrow pad and strapping without pressure are applied for 48 hours. Skin stitches are removed on the fourth day

FIG. 5.—Rycroft rhinostomy needles. These needles measure $\frac{1}{4}$ " between the point and the ferrule (A. W. Showell and Co., Ltd.).

and the rubber tube is withdrawn at the end of a week. Daily lacrimal irrigations for a further 10 days from the third post-operative day complete treatment. A control dacryo-cystogram is taken before the patient is discharged from hospital.

(5) **CANALICULO-RHINOSTOMY.**—This operation, first described by Arruga (1935), has been employed in those cases where the lacrimal sac had been removed but where the inferior canaliculus was intact. The operative procedure is the same as that described above, except that the lacrimal sac flaps are absent and the lateral flaps have to be fashioned from neighbouring scar tissue and deep fascia. This area is tented in the same way by a probe in the canaliculus and flaps can easily be made from the scar tissue. It is important that these flaps should be large and that the nasal mucosa should be widely mobilized to avoid tension.

The inferior canaliculus mucosa should be brought closely to the nasal mucosa if epithelial continuity is later to be established. Buried as it is in scar tissue, there is a great tendency for the medial end of the canaliculus opening to close. To avoid this a nylon or silk suture is retained in the new channel for three months. The suture is fixed above to the forehead and emerges at the nostril to be fixed on the lateral malar prominence. The upper end of the suture should not also be brought on to the cheek but should be fixed to the forehead so as to avoid eversion of the inferior punctum. Long retention of the obturator is essential if the new channel is not to close. In spite of this retention suture the canaliculus opening often closes after a time and a method is being investigated at present whereby a new sac is constructed from buccal mucosa to establish continuity of mucous membrane between the medial end of the inferior canaliculus and the nasal mucosa. Late results of permanent drainage by canaliculo-rhinostomy alone have not been entirely satisfactory.

(6) **CONJUNCTIVO-DACRYOCYSTOSTOMY.**—Stallard (1950) described this operation for use when both canaliculi are out of action but where the sac and naso-lacrimal duct are intact. The fundus of the sac is cut off and the opening implanted in the conjunctival fornix.

Three practical difficulties have been encountered in the use of this operation:

(1) It is rare to find an injury which cleanly divides both canaliculi but which does not in any way damage the lacrimal sac.

(2) If the sac is closed off from external approach it is difficult to determine the patency of the main lacrimal duct beforehand. To open the sac is to risk cicatrization and it is a formidable and painful manoeuvre to establish patency by way of the inferior meatus.

(3) When the sac has been transposed it has been found difficult to keep the conjunctival opening permanently patent.

For these reasons, therefore, my success with this operation has been limited to one out of four attempts. Bony fracture and adhesion of the sac were complications and free mobilization of the sac has proved difficult.

FIG. 6.—Cantho-cystostomy. Fracture of maxilla and nasal bones, inferior canaliculus obliterated by scar tissue, main duct and upper canaliculus patent. The lateral wall of the sac has been divided into anterior and posterior flaps which are held by hooks. The medial wall of the sac is exposed. Note deep healed scars in surrounding skin.

(7) CANTHO-CYSTOSTOMY.—If the lower canaliculus alone is obliterated but the superior canaliculus is patent, it is quite feasible to open up the entire lateral wall of the lacrimal sac into the lacus lacrimalis (Figs 6 and 7). A sharp Weber knife is inserted in the upper punctum and the lid is put on the stretch. Conjunctiva is held out of the way by plastic hooks. The upper canaliculus and lateral wall of the sac are then slit right down to the opening of the naso-lacrimal duct and two flaps are thus produced. The anterior flap is stitched by two or three stitches forward and the posterior flap is trimmed level or sutured; the opening is packed for 8 to 10 days and thereafter lacrimal irrigation is commenced. It is essential that the opening should extend well below the level of the lacus and into the naso-lacrimal duct or else a bridge of tissue may form which will subsequently require cauterization to ensure free drainage. Three cases treated by this operation are all free from epiphora 6 to 8 months after operation.

FIG. 7.—Same case as Fig. 6. One month later, a bridge of tissue had crossed the lower end of the opening; this was cauterized. Drainage was free. Six months later the patient had no epiphora when working as woodman and forester. The lower lid is pulled down for demonstration.

(8) **CANTHO-RHINOSTOMY.**—This operation is performed where neither canaliculi nor sac are available. Examples of such cases are previous dacrycystectomy, extensive burns, bony trauma, and wide excision of tissues following radium treatment of malignant disease.

The initial steps of the operation are the same as for dacry-cysto-rhinostomy, but bleeding is generally more difficult to control. Also much scar tissue has to be excised to get clean exposure of bone.

When the bony opening is made, the nasal mucosa is generally found to be scarred and degenerate; this is not utilized but is cleared completely from the edges of the bony opening. A tube of buccal mucosa measuring 1" x $\frac{1}{2}$ " is next prepared and stitched over and on to an acrylic tube (Fig. 8). This tube (size Jaques No. 3 catheter) is passed through a stab incision at the inner canthus in front of the plica and at the lowest level of the lacus, and through the bony opening into the nose. The upper end of the mucous tube is stitched to conjunctiva by three sutures of fine black silk and the acrylic tube is retained in position for three months. Results of this operation so far show that seven of eleven cases have no outdoor epiphora three months after removal of the tube. For this kind of drainage, a large opening into the nose is not desirable since it is well known that epiphora sometimes continues although the patient has a large bony opening into the nose. The aim is to obtain a liquid column of capillarity from the inferior conjunctival fornix to the middle meatus of the nose, and the direction of the mucous tube is almost vertical. It is not known what influence the cilia or orbicularis pressure has in this type of lacrimal drainage (Fig. 9). The patient shown here was a tailor who had had a severe central and lateral middle third fracture with sac destruction, and epiphora was a handicap in his employment.

FIG. 8.—Left cantho-rhinostomy. Tube in position in nose and upper end of mucous membrane graft seen at the inner canthus where it is fixed by three stitches.

FIG. 9.—Right cantho-rhinostomy. Conjunctival opening seen seven months after operation; there is no epiphora and the tube is freely patent.

(9) **MINOR ASSOCIATED PROCEDURES.**—For eversion of the inferior punctum without stenosis or ectropion, galvano-puncture is very useful. Three deep punctures of the electro-cautery at bright-red heat are made 2 mm. below the line of the inferior canaliculus. Where, however, the inferior canaliculus is also stenosed from long disuse or damage, the

posterior wall is freely excised in a triangular fashion (canaliculectomy or three-snip operation). Care is taken to carry the excision of conjunctival mucosa well beyond the stricture and, if necessary, into the neck of the lacrimal sac, and to pack the opening for 48 hours to prevent premature closure. Where there is epiphora of long duration, there may be secondary hypertrophy of the caruncle from irritation. It is occasionally necessary to cauterize the caruncle to avoid blocking an enlarged inferior punctum.

SUMMARY

The relief of epiphora due to obstruction of lacrimal drainage lies in the province of the ophthalmologist. Simplified operative techniques and new instruments are described.

(1) Dacryo-adenectomy and dacryo-cystectomy are not recommended for the treatment of obstructive epiphora.

(2) Where sac and canaliculi are intact, dacryo-cystostomy is the operation of choice, preferably by the method of Dupuy-Dutemps employing anterior and posterior sutured flaps.

(3) Where the inferior canaliculus is intact but the lacrimal sac has been removed, canaliculo-rhinostomy (Arruga) has been employed. Owing to poor late results, a method of mucous membrane inlay is being tried.

(4) Where the upper canaliculus, sac, and duct, are intact but the inferior canaliculus is obliterated, simple cantho-cystostomy, or the opening of the lacrimal sac into the conjunctival fornix, restores lacrimal drainage.

(5) Where lacrimal sac and canaliculi are both absent, drainage can be re-established by cantho-rhinostomy, employing a tube of buccal mucous membrane from the conjunctival fornix to the nose.

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