This reduction in the death rate can be attributed to the following causes: (a) the use of general anaesthesia is avoided; (b) surgical trauma is lessened; (c) the danger of secondary infection is greatly reduced.

Morbidity.—The period of illness is shortened, the average number of days of drainage being 25.06 days, while the average by the open method is six weeks. In my early cases the tube was left in the chest an unnecessarily long period; had these early cases been treated in the same manner as the later ones the average number of days of drainage would have been considerably reduced. This shortening of the period of drainage can be accounted for, first, by the action of the Dakin's solution in overcoming the infection and by its power of softening the exudate covering the lung surface, and secondly, by the assistance of negative pressure in expanding the lung and obliterating the cavity.

Another advantage of the method by no means unimportant is the elimination of the usual painful daily dressing, as anyone who has had experience with the open method of treating this condition in children can testify.

INTRANASAL DACRYOCYSTOSTOMY FOR RELIEF OF LACRYMAL OBSTRUCTION

AN ANALYSIS OF 63 CASES*

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The not infrequent failure of conservative treatment and the disappointments following extirpation or curettage of the tear sac for the relief of lacrymal obstruction have induced surgeons from time to time to attempt various methods in an endeavour to re-establish permanent intranasal drainage of the lacrymal apparatus.

HISTORY

With this end in view, the tear drainage apparatus has been approached surgically in three directions: (1) externally through the skin, (2) transantrally, that is, through the maxillary antrum, and (3) intranasally.

In 1904 Toti¹ described his external operation of "dacryocystorrhinostomie" in which, by an external incision, a communication is made between the lacrymal sac and the nasal passage. I have no personal experience of this method, but the best results are said to be obtained with large tear sacs, while there is some risk of injuring the delicate canaliculi. Mr. E. D. D. Davis,² however, prefers Toti's external operation, even in the presence of a suppurating sac or an external fistula, and finds it mechanically an easier and surer method than West's operation. Ten cases so treated were all successful. V. Eicken adopted a transantral approach, but the difficulties of the operation and the anatomical fact that the sac cannot be drained without removing some of the floor of the orbit soon prejudiced this method.

The intranasal route was first adopted by Caldwell in 1893, when he opened and drained the tear duct intranasally after a preliminary resection of the anterior end of the inferior turbinate bone. Similar attempts were made by Killian, Passow, and Okunoff. Between 1908 and 1910 West operated in seven cases, but he approached the nasal duct above the inferior turbinate body. He soon realized, however, that the obstruction lay at the junction of the tear duct with its sac and not at its lower

nasal opening. Strazza in 1903 was the first to open the tear sac intranasally, but he did so by first exposing and opening the tear duct and tracing it upwards to the sac. To West³ of Berlin, and to Dr. R. D. Paterson of Cardiff, belongs the credit of being the first to approach the sac directly. The operation of intranasal drainage of the lacrymal sac (intranasal dacryocystostomy) is therefore frequently termed "West's operation." J. S. Fraser of Edinburgh, who has done much to perfect this operation and place it on a sound basis, first performed it in 1915, and has recently⁴ reported his results—seventy-five cures in eighty-nine West operations.

Between 1923 and 1929 I have, through the kindness of my colleagues on the staff of the Manchester Eye Hospital, performed seventy-nine West operations. The results, at least nine months after operation, have been traced in sixty-three cases. From a study of the records of these, an attempt has been made to obtain some information of the prospects of a permanent cure following intranasal dacryocystostomy, and also to ascertain the features that should guide us in making a selection of suitable cases.

TECHNIQUE

The success of the operation depends so much on its technique that, although the method has been so well described by West, Fraser, and others, a few details seem worth mentioning which from experience I have come to regard as important. Briefly stated, intranasal dacryocystostomy consists in the intranasal exposure and removal of the nasal wall of the tear sac, as it lies in the bony lacrymal groove, by removing the overlying nasal mucosa and bone. Anatomically, the lacrymal sac, in the majority of instances, is related intranasally to that region of the nose just in front of the anterior attachment and upper half of the anterior free border of the middle turbinal body.

Like Mr. Fraser I have abandoned local anaesthesia. The posterior margin of the frontal process of the superior maxilla, as it forms the anterior boundary of the lacrymal fossa, is occasionally too dense to remove comfortably with local anaesthesia alone.

About ten minutes before the induction of general anaesthesia the mucous membrane just in front of the anterior attachment and anterior border of the middle turbinate is injected with 1 per cent. novocain-adrenaline solution (2 to 3 minims of adrenaline to 1 drachm of 1 per cent. novocain), the nose having previously been well packed with the usual cocaine-adrenaline gauze. The local ischaemia thus produced is a distinct advantage, though in a few instances, in spite of this injection, troublesome haemorrhage has considerably increased the difficulties of the operation.

Anterior middle turbinectomy was performed in only nine cases. It should be avoided, unless absolutely necessary to gain access, as the persistent oozing of blood tends to obscure the field of operation. Anatomically it is rarely demanded, since Thorsch and others have demonstrated that in fully 65 per cent. of cases the middle turbinate body lies behind the lacrymal groove.

The nasal wall of the tear sac should be thoroughly exposed by a liberal removal of the overlying bone, otherwise granulations growing from the cut bony margins will, in course of time, coalesce and completely occlude the new ostium. I have found a long narrow and slightly curved chisel more effective and easier to manipulate than a gouge; in fact, I rarely use the latter, except, perhaps, to trim the margins. Having exposed the bone of the lacrymal fossa intranasally by the removal of a square-shaped piece of mucous membrane, I proceed to remove it in one piece. Three incisions with the chisel are made at the extreme anterior, upper, and lower boundaries of the exposed bone. They are joined anteriorly, while

* A paper read before the North of England Ophthalmological Society, October, 1930.

posteriorly the transverse incisions pass through the posterior margin of the frontal process of the superior maxilla. Each of the three bony incisions is deepened to the outer periosteum, and the outward penetration of the chisel is judged by placing the fingers of the left hand over the lacrymal fossa externally. I prefer to use my own fingers than to rely on those of an assistant.

In making these incisions the chisel is applied in the correct position under vision, and while held thus in the right hand is struck with the mallet by an assistant. With a fairly strong nasal raspator, passed through the anterior incision, the square-shaped piece of bone thus delineated is separated from its outer periosteum and prised out of its bed by a leverage movement. The separated bone can then be lifted out of the nose with a pair of fine Luc's forceps, which may also be used to remove the thin lacrymal bone, or any other surrounding spicules of bone, until there is adequate exposure of the tear sac.

After trying many methods and instruments to remove the inner sac wall—often the most difficult step in the operation—I have found Paterson's long tenaculum forceps, specially designed for this operation, to be the most satisfactory. A fine lacrymal probe passed along the lower canaliculus makes the tear sac "tent" inwards. It is then seized with the tenaculum forceps drawn inwards, and on removal of the probe the protruding portion of the sac wall is excised with a long slender and very sharp knife, applied as close to the outer nasal wall as possible. If necessary, the opening thus made can be further enlarged by piecemeal removal with biting forceps of the Grunwald pattern. This, I find, is by no means easy with thin-walled sacs, for, when once the sac is opened and its contents have escaped, it is difficult to engage the blade of the biting forceps in the lips of the opening.

The opening into the sac should be large, and in my opinion should be at the most dependent part of the sac, otherwise tears will tend to collect in the lower part of the sac and keep up a certain amount of suppuration. To make the opening as dependent as possible I cause the lowest part of the sac to "tent" with the lacrymal probe before excision by raising the outer part of the probe when its inner end is engaged in the sac. The efficiency and size of the opening should be tested by washing out the sac with a syringe and cannula, the point of the cannula being inserted only just inside the lower canaliculus. If the fluid tends to regurgitate through the upper puncture, though it may also be entering the nose, or if there is any obvious swelling of the sac, or even if fluid can be further expressed from the sac after syringing, the opening needs further enlarging. Time taken in ensuring an adequate opening is well spent.

AFTER-TREATMENT

Tamponage of the nose with gauze should be avoided, unless absolutely necessary to control haemorrhage, since, in my opinion, it is apt to seal together the lips of the opening in the sac wall. On the second day the sac can be gently cleansed with saline solution, and this should be repeated, if the sac contains much pus, every second day for ten to fourteen days. The cannula should only just be engaged in the lower canaliculus, and not passed into the sac or even pushed through the artificial ostium into the nose. Lavage not only cleanses the sac of pus, but it prevents dried blood accumulating around the lips of the artificial ostium, which from organization and cicatrization might tend to promote its stenosis, or even complete closure. No special intranasal medication is required other than spraying the nose once or twice daily for the first ten days with a simple menthol and paroleine solution.

RESULTS OF WEST'S OPERATION

Of the 63 West operations which have been traced, 46 (73 per cent.) were completely successful—that is, the epiphora was completely cured, even when the patient was out of doors; there was, of course, no enlargement of, or suppuration in, the sac. Six of the remaining 17 cases may perhaps be regarded as moderate cures in that, although there was some slight epiphora out of doors, there was no longer any distension of the sac or recurrent attacks of acute dacryocystitis. In each of these six cases persistent epiphora and dacryocystitis had been a source of real discomfort to the patients, four of whom considered they were really cured.

Eleven (17 per cent.) were absolute failures. A brief survey of the case records of these patients may indicate the cause of failure. Four gave a history of recurrent dacryocystitis; in two of these it was noted in the case records that considerable difficulty was experienced in passing the lacrymal probe along the canaliculus, a kinking of the canaliculus being suspected. Severe bleeding, obscuring the field of operation, was mentioned in three cases, while in four there was no apparent cause. My second West operation was performed in one of these cases; two others were apparent successes two or three months after operation, but later were complete failures. Presumably an inefficient removal of bone with subsequent stenosis was the explanation.

In 1925 Mr. J. S. Fraser⁵ reported 73 per cent. of cures, and four years later 75 per cent. in a series of 89 West operations. A cure rate, therefore, round about 73 to 75 per cent. is, I think, the experience of all those who have essayed the procedure on any large scale.

GENERAL PRINCIPLES IN SELECTION OF SUITABLE CASES

The age of the patient, the size and width of the nose and its nasal passages, will generally be the determining factors whether a case is suitable for a West operation or not. Obviously there must be sufficient room to gain access so that delicate and difficult intranasal surgery can be performed under clear vision. An enlarged middle turbinate, or a nasal septum deviated to the side of the lesion interfering with adequate access, can be easily overcome by a partial turbinectomy and by a submucous resection operation respectively. Anterior middle turbinectomy, for reasons already given, should be avoided as far as possible. For large hypertrophies completely preventing access, I now prefer to remove the superfluous tissue under local anaesthesia a few weeks before resorting to the West operation. A submucous resection of the nasal septum which was found necessary in 11 cases was done as a preliminary under the same anaesthesia. If adequate access is at all doubtful, a resection of the nasal septum is always worth while, as the additional room gained is considerable. Some surgeons have advocated a transeptal approach to the tear sac—when operating, for example, on the right sac, to approach it from the left nasal passage through the nasal septum after resecting the cartilage. I have not yet had occasion to do this, as the additional room provided by a resection of the nasal septum has given adequate access.

A West operation should not be attempted in the presence of active lupoid or syphilitic disease of the nose, for obvious reasons. Hypertrophic or atrophic rhinitis (with or without ozaena) does not *per se* prejudice a successful result. Suppuration in a nasal sinus, particularly if any of the anterior group is involved, should first be corrected. In a paper read in the Section of Ophthalmology at the Annual Meeting of the British Medical Association in 1927,⁶ I referred to the relationship between nasal sinus infection and lacrymal obstruction,

and reported two interesting cases of closed ethmoidal empyema which had been completely cured of epiphora by drainage of the ethmoidal labyrinth alone. The incidence of nasal sinus infection in lacrymal obstruction, as was shown in that communication, is, however, rare, and I do not wish to convey the impression that the cure of suppuration in an interior nasal sinus will always relieve epiphora.

It is of course essential to ascertain before the operation that there is no abnormality or stenosis in the puncta and canaliculi, otherwise an artificial intranasal opening of the lacrymal sac will spontaneously close if tears are unable to flow along the canaliculi. If Bowman's operation (slitting of the lower canaliculus) is accurately performed, it would not seem to preclude a successful result, as was indicated in four cases in the present series.

In regard to the lacrymal sac an external sinus discharging at the time of the operation, provided it is not acutely inflamed, does not of itself prejudice a successful West operation. The sinus should be gently scraped with a fine curette and a very light dressing applied. This was done three times in the present series with successful results in each case. If the sinus is acutely inflamed, external drainage should be maintained until all inflammation has subsided.

Occasionally pressure with the finger over the sac causes its contents to flow into the nose rather than along the canaliculus, although epiphora and distension of the sac may be present. Fraser considers that a West operation in these circumstances is not likely to be so successful. In the present series such a condition was noted in five cases, two of which were failures. While the figures are interesting, they are obviously too small to furnish any conclusions.

There can, I think, be no doubt that the operation is relatively easier with thick-walled than thin-walled, scarcely palpable sacs; yet in the present series of 63 West operations the consistency of the sac wall would of itself seem to have no bearing on the end-result. The consistency of the sac was recorded in 45 cases—namely, thin-walled in 11 and thick-walled in 34. Unsuccessful West operations were performed on three (approximately 27 per cent.) of the thin-walled sacs and 10 (29 per cent.) of the thick-walled sacs. Other factors, such as recurrent acute dacryocystitis with possible cicatricial kinking or inflammatory stenosis of the canaliculus, a history of which was obtainable in the majority, no doubt prejudiced a favourable result in what was, apart from the consistency of the sac, an easy operation.

Intranasal dacryocystostomy should not be attempted when the tear sac is acutely inflamed. The inflammatory condition must be treated on the usual lines by an external incision, if necessary, and at least six weeks should elapse after subsidence of the acute phase before resorting to a West operation. Excessive bleeding otherwise adds considerably to the difficulties of the operation, while there is the added risk of exciting a serious spreading septic osteomyelitis of the facial bones.

I have the impression that recurrent attacks of acute dacryocystitis with abscess formation, which have either spontaneously discharged externally or been incised, prejudice a successful result. The sac wall is often very firm and thick; the contents of the sac cannot be expressed either along the canaliculi or into the nose; and there is occasional difficulty at the operation in passing the lacrymal probe into the sac. It is interesting to note that such a history of recurrent dacryocystitis accounted for four of the eleven complete failures. A history of dacryocystitis, however, either single or recurrent, occurred seventeen times in the total series of 63 West operations, eleven successes, two moderate

results, and four failures being recorded. None of the patients with successful or moderate results had, however, had more than one attack of acute dacryocystitis. It would appear, therefore, that, although a single attack of acute dacryocystitis does not prejudice a successful issue, yet recurrent inflammations producing thick-walled sacs, perhaps loculated with malformation, kinking, or inflammatory stenosis of the canaliculi, though not a definite contraindication, are not so likely to yield successful results.

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RECONSTRUCTION OF THE FOREARM AFTER AMPUTATION OF THE HAND

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In 1928 I described an osteoplastic operation, performed in the previous year; my object was to make the forearm prehensile after complete loss of a hand.¹ My first patient was an Egyptian policeman whose left hand had been cut off in a tramway accident, and in December, 1928, one and a half years after the operation, he demonstrated the strong and adroit function of his reconstructed limb before the Surgical Section of the International Congress of Tropical Medicine. This result encouraged me to repeat the reconstruction at the first opportunity, and in the same year, through the courtesy of Professor Ali Bey Ibrahim, who sent me the case, I performed a similar operation, this time on the right forearm of a boy aged 8 (Fig. 1).

AIM OF THE OPERATION

The aim is to make a new digit provided with bone, tendinous attachments, and skin, and nourished by the radial trunk; this digit is allowed to become ankylosed with the shaft of the radius at such an angle that the movement of pronation brings it into firm contact with a stiff artificial finger attached to a gauntlet fitting the stump; grip and its relaxation are thus secured by pronating and supinating the forearm.

The initial difficulty was to obtain an aseptic field in the granulating stump, and I knew that if I discharged the boy from hospital to live down latent infection, his family would soon be content to leave his forearm useless. For this reason I tried, as I had tried in my first case, to rid the unhealed stump of sepsis by means of the high-frequency current. In neither patient was this attempt entirely successful, but the subsequent reaction in both was mild, and did not harm the new digit.

THE OPERATION

I repeated the two-stage procedure of the first operation at one sitting.

Stage I.—With sparks from the high-frequency apparatus, I began by charring the granulations of the stump, and also an inch-wide margin of skin. I then coagulated the region of the carpus; the limb was cleaned afresh with ether and a 5 per cent. solution of picric acid in alcohol, and after a change of gloves and instruments I began the second stage of the operation.

Stage II.—A circular disarticulation dividing the skin just distal to the radial styloid removed the remains of the