FENESTRATION OPERATION

EXPERIENCE OF FIRST NINETY-SIX (CONSECUTIVE) CASES

By R. THOMAS (York)

MOST people, when discussing the surgery of otosclerosis, frequently refer to the work of otologists abroad and particularly Lempert. Nevertheless, in this country we also owe a great deal of gratitude to our few pioneers who, during the last decade or so, despite initial failure, scepticism and the interruptions of war have successfully performed the operation and demonstrated how it should be done. Of the many beginners I at least am very grateful to Cawthorne for his encouragement in this as in so many other points of otolaryngology.

There is nothing new in this series of cases and observations and I hope colleagues will forgive the repetition of matter which has been fully discussed in so many journals. This article is written in response to Passe's remark at the Royal Society of Medicine, February 1950 (*re* few published results in this country), as of the "neo-fenestrators" Lumsden[11] alone has published his experiences. I hope at least the records of the failures will be of interest and that opinions based on this comparatively small number of cases will be tolerated. The purpose of this article, which is not comprehensive, is to stimulate further interest in this new and very broad subject and to emphasize that the results of the operation compare favourably with any other surgical procedure provided the basic principles are adhered to.

If the operation is properly performed on the worse ear little permanent harm is done to the patient in the event of failure. Success, however, will frequently effect during the ensuing year, a remarkable transformation in the patient's demeanour and activities which might be the subject of a separate psychological study; for the busy otologist is hardly in a position to do more than welcome the obvious improvements. The published long-term results are good and no doubt, as technique improves, the surgeon will soon be able to estimate a higher percentage of lasting successes when discussing the prognosis of the operation with the patient. The operation is not dangerous and often is hardly more upsetting than other mastoid operations. The care with which cases should be selected and the estimate to the patient of the chances of success could well be applied to some other operations whose indications are not so clear. As I hope to show below, the surgeon is the cause of failure, not the operation.[2,3]

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Results

The hearing result can be expressed semi-scientifically in decibels or speech tests. These are fairly easy to report, but do not necessarily indicate the result to the patient whose life may be considerably altered, a factor which is not assessable in figures and may not even relate to the new hearing level.[9] For instance, Case 25, who had a 70 db. loss is rather critical of his new 25 db. level which he frequently tests as he is a telephone linesman. Case 17 had a 70 db. loss and seldom went from

RESULTS

(Table Refers to Speech Frequencies, 512, 1024, 2048 only).

Case No.	No. of pre-operative BONE conduction frequencies of 30 db. or better	Average post-operative AIR conduction gain db.	No. of post-operative AIR conduction levels of 35 db. or better	Hearing gain maintained	Remarks
Cases operated on more than 2 years ago.					
1	3	23	3	Yes	
2	3	20	3	Yes	
3	3	26	0	Yes	
4	3	23	0	Yes	* Despite operation failure
5	3	20	1	Yes	
6	3	30	1	Yes	
7	3	35	3	Yes	
8	0	41	1	Yes	
9	2	27	0	Yes	
10	3	18	1	Yes	
11	1	0	1	0	Not conduction deafness
12	3	23	2	Yes	? ? Slight deterioration after 2 years
13	1	30	0	No	Late closure. Refuses hearing aid
14	3	40	3	Yes	
15	3	38	3	Yes	
16	0	30	0	Yes	
17	2	13	0	Yes	One year after revision
18	1	17	0	Yes	*
19	0	28	0	Yes	
20	3	21	1	Yes	
21	3	17	0	No	Also Case 61. Early closure
22	2	40	1	Yes	
23	3	18	2	Yes	
24	3	30	3	Yes	
25	3	43	3	Yes	
26	3	13	1	Yes	Despite operation failure
27	2	0	0	0	Failure for no obvious reason
28	3	25	1	Yes	*
29	3	26	3	Yes	
30	3	23	1	Yes	*
31	3	0	0	0	Worse. Wears aid
32	3	35	2	Yes	

Best possible interpretation 84 per cent. success.
Worst possible interpretation 65 per cent. success.

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Fenestration Operation

Case No.	No. of pre-operative BONE conduction frequencies of 30db. or better	Average post-operative AIR conduction gain db.	No. of post-operative AIR conduction levels of 35 db. or better	Hearing gain maintained	Remarks
Cases operated more than 1½ years ago.					
33	3	30	3	Yes	
34	1	0	0	0	Worse. Wears aid
35	3	23	3	Yes	
36	3	20	3	Yes	
37	3	?0	0	0	Says operated ear now the better. Wears aid
38	3	38	3	Yes	
39	3	26	2	Yes	
40	3	25	2	Yes	
41	3	25	1	Yes	
42	2	31	3	Yes	
43	3	28	2	Yes	
44	3	31	3	Yes	
45	3	28	3	Yes	
46	3	31	2	Yes	
47	1	25	1	Yes	*
48	3	20	3	No	Late closure
49	3	23	3	Yes	
Cases operated more than 1 year ago					
50	3	25	3	Yes	
51	3	35	1	Yes	
52	3	25	3	No	Wears aid. Worse. Early closure
53	3	27	2	Yes	
54	2	33	1	Yes	
55	3	33	3	Yes	
56	0	36	2	Yes	
57	3	28	1	Yes	
58	2	?	0	No	Early closure
59	3	36	3	Yes	
60	3	17	1	Yes	
61	3	18	2	Yes	
62	3	33	3	Yes	

Of the remaining 34 cases (operated less than a year ago and still under review) there have been 31 initial successes and the three failures quoted in the text.
Total Cases, 96. Best interpretation of initial success, 90 per cent.

home until after her operation which gave her a 40 db. level. She became a city councillor within a year of the operation.

The tables show the hearing results of the first 96 cases. The hearing gain is expressed as the average of the gains of the three speech frequencies. It will be seen that well over 80 per cent. have a useful improvement which they have maintained. A very optimistic estimate shows a 90 per cent. initial success. The failures were not all due to bad operations.

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These figures represent the best possible interpretation of the table. They include, however, the following :

(1) Five cases with perforated ear drums (marked *). Case 4 and Case 18 have perforations in the drum as the result of clumsy surgery and Cases 28, 30 and 47 developed perforations during the post-operative period, due perhaps to the overuse of penicillin and sulphadiazine powder. In each case there is some improvement. However, if (as mentioned by Juers[7]) the perforation is covered with a piece of cellophane kept in place by a (sound-damping) cotton wick soaked in gentian violet, each has the good result shown in the table. One such plug has been left in for 4 months without ill-effect. Only in Case 47 is the perforation healing and the final result should be good. Of the other four, two attend for insertion of the pack, one attends occasionally, one wears a hearing aid in her unoperated ear which is rapidly deteriorating. The last two are definitely failures, but if they were able to attend regularly, they would be able to manage without further trouble.

(2) Case 26 shows some improvement but it is a surgical failure ; both the drum and the flap were torn by the bone forceps slipping. There is good fistula sign and some improvement. Tinnitus has also improved.

(3) Case 17 was revised as fibrous bands developed throughout the cavity (due to excessive granulations). The table shows her level one year after this revision. There was no bony closure. The hearing in the operated ear has deteriorated slightly again, but is still 15 db. better than the other.

Late closure has not so far been a feature of my cases although I must admit that a few show a 5 or 10 db. loss at 512 during the second year which is often offset by a similar improvement at 2048. Is this due to partial closure or to alteration in the characteristics of the fenestra or even to the audiometer ?

Bone conduction has obviously increased in some of the cases.[15] The unoperated ear has deteriorated by more than 10 db. in six, and in a very few instances appears to have improved a little.[14]

Case 21 (given " no " in column 4) and Case 61 are the two ears of the same patient, age 57, who had an initial success but maintained only a slight improvement after the first operation making the operated ear the better ear. I thought it better to operate on the other ear than to revise, and she now has an excellent improvement after being deaf for 50 years. She tests her hearing by the bells of York Minster, and says she can hear them half a mile farther away than she could before the operation ; (she does not, however, allow for wind, etc. !). These patients make very interesting remarks ; one patient was entranced by the sound of a cat purring which he said he had not heard before.

Consideration of these results should also be tempered with the fact that all the tests and the dressings were made by the surgeon. His

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enthusiasm and the patients' increasing familiarity with him and the test may have played their part in emphasizing the improvement. However, the hearing level in the unoperated ear remains a useful guide to the accuracy of the pre-operative tests. Also the tests were not done in ideal conditions; a test in a sound-proof room might show that there is a greater number of cases whose hearing has reached a " practical level ", which at present I prefer to regard as 35 db. on my audiometers (Peters').

It is interesting to note that the number of cases with frequencies of " practical level " (about 50 per cent.) has not notably increased with the presumably increasing skill in later cases. This suggests that the operation is a purely mechanical procedure and that a successful result, apart from the individual variations due to size of fenestra and thickness of flap, depends entirely on the indications.[2]

Indications

Except for occasional flights of optimism, the indications I have followed in the main have been those which have been frequently discussed in the journals[6, 10, 12, 13, etc.,] and at Society meetings. However, the patients who come my way do not always fall into a particular category. Certainly few have an air conduction loss of less than 45 db. and fewer still have an audiometrically normal bone conduction under the conditions of my test. It will be interesting to compare the results of this series with further cases tested in the sound-proof room which is now being constructed at York County Hospital. I have relied almost entirely on audiometric tests (Peters' audiometers). After spending half an hour or so in taking the history and testing the patient, I have always tried to estimate to him or her the value of the operation. This estimate is based on the following considerations:

(1) Post-operative air conduction will probably be less than pre-operative bone conduction. (Only 35 per cent. of my successes have one or more air conduction frequencies equal to their pre-operative bone conduction.)

(2) If there is sufficient difference between pre-operative bone conduction and air conduction (which there should be)[10] the improvement will average 25 db. for each of the three frequencies.[1]

(3) If there is a very big difference between air conduction and bone conduction there may be an exceptional improvement.[2]

(4) Most patients want to hear conversation with at least one person; some are more exacting. It is of little advantage to either patient or operation if this level is not obtained, unless it is true that the operation retards the progress of the disease.

The title " Fenestration for Otosclerosis " was purposely not used as

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it suggests that the operation is the treatment for the disease. If the usual diagnostic criteria are adopted most otologists must have seen a large number of cases of otosclerosis since the government hearing-aid scheme started; very few of these unfortunate people can be helped by fenestration unless it is true that the progress of the disease is retarded by the operation. Until this can be proved conclusively by eminent surgeons[13] it would appear that there can be no excuse for neo-fenestrators regarding it as an indication for operation.

In this series it appears that the cases who do not obviously suffer from otosclerosis have been benefited by the operation.

Case 80 was deaf for 14 years following bilateral cortical mastoid operation[6] at age 9. Both ears had been dry since. The fenestration was uneventful and successful and the cavity remains dry, except for a few days when she had a cold.

Case 86 had been deaf for 22 years in the operated ear. There was scar tissue in the attic and aditus and around the malleus, incus and stapes which was obviously mobile. The operation gave him the usual improvement.

I do not see that anything else could have been done for these two cases. Would it have been better to regard as suitable any case of chronic untreatable conductive deafness where the drum is intact, the bone conduction good and there is no active inflammation ?[8]

There is real difficulty in estimating the value of the operation to the case whose air conduction levels differ by 20 db. or more. The history is usually that one ear has been deaf for many years and now the "good" one is getting worse. One could always say to the patient: "The operation can make your deaf ear as good as the good one; if the operation is a success the good ear can then be done with an excellent result. This means two operations—one might be a failure; you had better wear an aid for a time." A lucky example of this type is Case 22 who had an 80 db. loss in one ear and 40 in the other which was getting worse; she had good bone conduction. The operation gave her a maintained 40 db. level. Her binaural hearing is now excellent; she can localize sound and carries out her duties well as a health visitor.

Operation

Except for unimportant modifications, I have tried to follow the technique so ably demonstrated by Cawthorne. It is probably immaterial what method is used, provided a thin flap is placed over a well-cut fenestra and the dressing is satisfactory. I suggest that first intention healing between the flap and bone is more likely if the fenestra is cut quickly with the least possible grinding and polishing, and if that small portion of the flap which is to lie over the fenestra is prepared at the last

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possible moment before fenestrating. I can find no reference in the literature of long-term results showing that any particular method is more or less likely to predispose these patients to chronic or intermittent discharge.

The average time of operation has been $1\frac{3}{4}$ hours, the longest $2\frac{1}{2}$ hours and the shortest 1 hour 10 minutes.

I have not as a rule had X-rays taken as I feel they may over-emphasize the difficulty of a case with poor pneumatization and perhaps give a sense of false security in the well-pneumatized. It would be interesting to study the relation between the radiological appearances and the operation findings; but at present I prefer to test the resources of the overtaxed X-ray department with cases of chronic otitis media.

Instruments

For the bone work and dissection of the meatus the usual mastoid instruments are used with the addition of two dental tools. Ash's Number 152 is invaluable as a periosteal elevator, for dissection of the endomeatal spine and for the rest of the meatal work. With it one can also dissect round the corner into the attic and break down cell walls as required. As it is cheap it can be frequently renewed and is valuable for other ear, nose and throat operations. Ash's Number 157-8 is also useful for finer work in narrow spaces. I do not always find telescopic spectacles necessary, but they are very valuable at times working in the depths of the meatus.

The microscope (made by Cooke, Troughton and Simms of York) gives good vision and illumination up to the magnification of $\times$ 15 with various eye-pieces. It has an easily adjustable stand (with ball joint) and the whole is covered with a sterile towel which has holes for the eye-pieces. Adjustments are easily made through the towel. The dental machine is very simple; there are two and a spare flex in case of break-down. The only burrs used for the microscope work are spherical diamond burrs, Solila numbers 55, 56 and 57. I tried long shanked burrs but in my hands they become eccentric and are not so controllable. Many types of pick have been tried; I find Ash's Numbers 5, 59, 60, 77, 94 most useful. A thick hypodermic needle with the attachment broken, when fitted into a dental nerve-instrument holder is an excellent tool for fine work; several can be used with their points bent at various angles.

Green cellophane and small pieces of sponge are used for packing the cavity. I have bent the blades of a Mollison's retractor so that they are now curved; this gives better exposure but the instrument is slightly more difficult to insert. The gentle and silent suction of a water valve has been safe except in one early case when most of the best part of the meatus was irretrievably lost.

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Anæsthesia

Without the patient and efficient co-operation of Dr. N. C. Porter it would have been difficult to do this work. He has used for the most part pentothal, repeated if necessary, and curare followed by endotracheal gas, oxygen and trilene. Thanks to his careful packing of the mouth and attachment of the apparatus there has never been an interruption of the operation by anæsthetic difficulties.

Hæmorrhage

Diathermy has not yet been used. I have often felt the want of it but still do not use it. In recent cases no preliminary hæmostatic injection has been made. Artery forceps have been left on the main vessels for a short time and the retractor completes hæmostasis from the soft tissues, except for a troublesome bleeding from the vessels on the upper surface of the membranous meatus which has always stopped in the course of time, as indeed do most small vessels. In one case the incision in the anterior wall of the meatus nicked a posteriorly placed posterior facial vein which was almost as big as a pencil. This caused very considerable difficulty which was eventually solved by a firm pack. Rubber aural syringes have been used for irrigation and eustachian catheters seem the most satisfactory suction tubes.

Technique

An endaural incision is used and an attempt is made to separate the upper and posterior part of the meatus first and to enter the attic. This I cannot always complete without some bone work. The endomeatal spine can usually be isolated by making an incision down on to it (Fig. 1) before dissecting the tissue from its prominence. It is often difficult to separate the meatus from the upper suture line.[5] The mastoid antrum is opened and only sufficient cells removed for access. The malleus head is removed with stitch scissors.

The final preparation of the meatal flap is left until just before fenestrating, and the flap is indicated in Figs. 2, 3, 4, and 5. This has certain advantages; the outer portion is used to epithelialize the upper part of the anterior wall of the cavity instead of lying on an area in the mastoid antrum which would in any case become covered by mastoid epithelium. Once this piece (ab) is out of the way (tucked forward under the retractor) the surgeon is able to visualize the amount of anterior wall he will require to bend back over the drum to cover the fenestration area correctly. The incision (xy) is made high up or low down, or even on the floor, accordingly. The flap is tucked away and covered with a cellophane slip to avoid bone dust and the possibility of engaging with the stem of the dental burr.

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Fenestration Operation

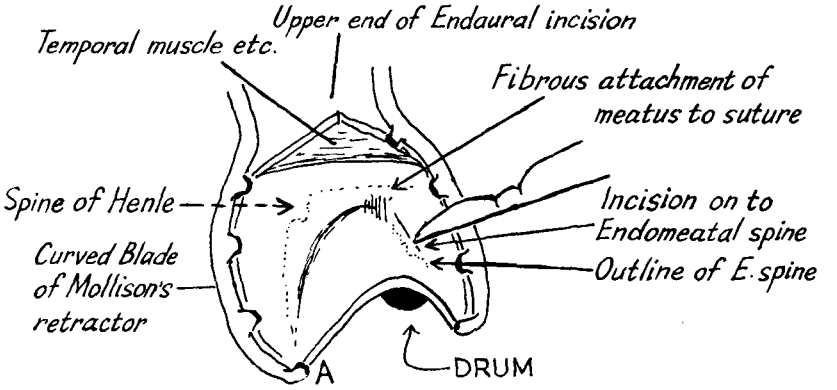


FIG. 1.
A method of approach.

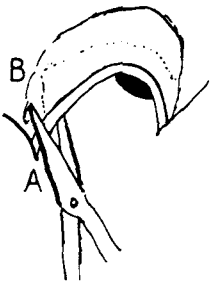


FIG. 2.

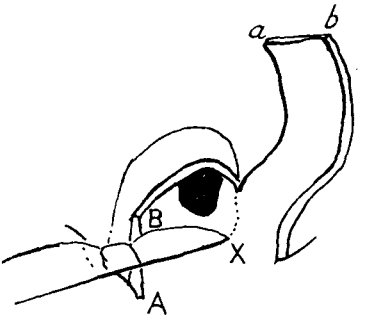


FIG. 3.

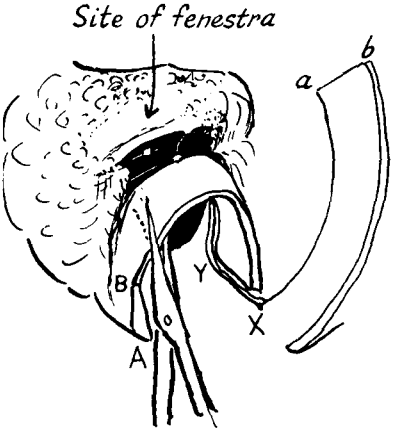


FIG. 4.

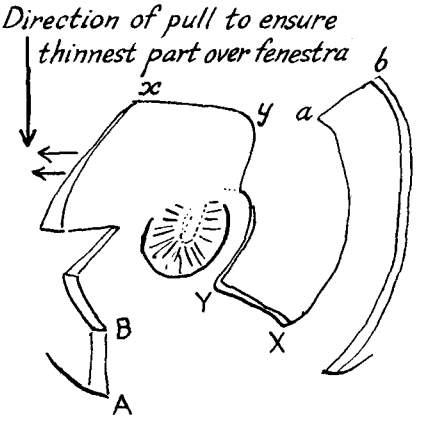


FIG. 5.

RIGHT EAR

Figs. 2, 3, 4, 5. Final stages of preparation of flap.

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For the microscopic work continuous irrigation is maintained by a tube (made from a thin frontal sinus catheter) held in the anterior part of the wound by an elastic band. By holding the suction tube in the left hand one can vary the depth and direction of the saline stream ; this facilitates both the cutting and the débridement of the fenestra. An attempt is made to follow the " contact " technique described by Simson Hall,[5] and burrs are not used once the labyrinth is exposed. Care is taken to remove any small pockets of bone dust which may have been ground into the enchondralized area. Every effort is made not to touch the membranous canal or rupture the labyrinthine vessels. No polishing or lead burr is used and the aim has been to place the flap over the fenestra at the earliest possible moment.

A piece of green cellophane the size of a sixpenny piece folded to enclose about ½ c.c. of sponge is pressed on the flap and the cavity sucked dry through the sponge. The sponge can then be removed and one is able to see through the transparent cellophane if the thinnest part of the flap is in the right place and to make adjustments if necessary. In addition to being transparent, cellophane has the advantage of being a very flexible, completely non-irritating and non-sticking dressing. The cavity is filled with more cellophane and sponge. There can be few less irritating materials than cellophane nor a more soft and elastic substance than the sea sponge so wisely suggested by Shambaugh.[13]

After-treatment

Following Shambaugh's[43] advice I have in later cases treated these wounds as little as possible with better results. The first dressing is done conveniently a week after operation, without an anæsthetic in most cases. Excessive blood clot, mucus and debris may have to be removed from time to time. Various applications have been tried but I generally return to tincture of merthiolate and aqueous gentian violet ; gentian violet 5 per cent. in spirit is also useful, particularly where there are many granulations, but is even more messy than the aqueous solution. Granulations have appeared at any time up to one year after operation and have been treated by instrumental removal and trichloracetic acid. The first is probably the better method.

Unless the surgeon introduces them organisms are unlikely to enter the presumably sterile cavity in the early stages ; if they did it would be by traversing the skin. There has been less post-operative sepsis since the skin around the entrance to the meatus has been painted at each of the first few dressings with tincture of merthiolate.

A premature return to work may lead to mild psychological disturbances. The sudden impact of this noisy world may make life puzzling for someone who has been deaf for many years. Quite a few of my patients have experienced this difficulty which has been overcome by

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reassurance and a gradual return to normal life. The exercises suggested by Cawthorne and Cooksey have been extremely useful but have not been used in every case. No post-operative inflation or aspiration of middle-ear contents has been done in this series.

Failures

Apart from the cases with perforated ear-drums (who require the treatment mentioned above to give them a reasonable improvement), Case 26 (who has a slight improvement despite a bad operation) and Case 17 who was revised with some success, there have been thirteen failures. No doubt some, whose operation was done less than a year ago, will fail—possibly others.

Faulty indications account for two.

Late closure: one, a group C case whose unoperated ear has also deteriorated considerably, and another, a girl aged 16 who has a keloidal flap. Both have still a good fistula sign.

Early closure (in each case within 4 months) accounts for four. Of these two say they hear better in the operated ear and have a minor audiometric improvement. Both these failures were due to faulty placing of the flap (in one the facial canal appeared to be on a much higher level than the external semicircular canal). The other two are mentioned below under " mistakes ". Serous labyrinthitis occurred in three. In one of these it was obvious that the fenestra had filled with blood before the flap could be placed over it.

Evulsion of the membranous labyrinth took place in one case mentioned below.

Only one patient has failed to improve despite adequate indications and surgery. Her fistula is very active. Her hearing remains the same.

With the possible exception of the two " late closures " and this last case mentioned I believe that the surgeon has been the sole cause of failure. Faulty indications, surgery or after-treatment have accounted for every one. Those otologists who are sceptical of the value of this operation should reserve their scepticism for the surgeon rather than the operative concept. With proper indications, surgery and after-treatment the operation should be initially successful in every case.

Unfortunately the failed case offers a lasting argument for those who do not advocate the operation; the hearing-aid adds what little extra is required to prove the case. The successful case who for years has tried to disguise his serious deafness is an adept at making the most of his new hearing level, and except in the early stages will not often wish to advertise his previous disability. It would seem a pity to form an opinion of the value of this procedure based on the failed cases of an era, when both indications and technique were in the experimental stage.

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The new techniques and the more rigid indications described by Lempert,[10] Shambaugh[13] and others will no doubt produce long-term results in a far greater percentage than hitherto reported.

Mistakes

The serious mistakes I have made have been :

Rupture of the drum and torn meatus (on two occasions). In each case this was done while lowering the meatal wall with double-acting bone forceps.

Allowing the thin part of the flap to be sucked away in the sucker. Fortunately sufficient anterior wall was found just to cover the fenestra. This case has a good result.

Evulsion of the membranous labyrinth. This occurred after I had been up most of the previous night with a sick relative. This may have been why I failed to notice that the head of the 1 mm. long-shank burr was no longer spherical, but had a large chip out of one side thus giving it a bigger bite. While I was making the upper blue line the burr entered the labyrinth and evulsed the canal which I subsequently unravelled from the burr. I could see clearly the edges of the torn ampulla. The flap was placed over the fenestra and the wound healed as usual. The result was unexpected. There was no unusual post-operative vertigo ; hearing with masking remains the same for 512 and 1024, but there is increased loss for the higher frequencies. A slight fistula sign can be elicited by pressure on the fenestra. The patient says that traffic occasionally sounds very loud in his ear.

It is obviously important to postpone the operation if one is over-tired and to follow Cawthorne's[1] advice to keep times for this work apart from ordinary operating lists.

There have been three cases of facial paralysis. These occurred before continuous suction-irrigation was used. Two recovered quickly and completely ; the other (Case 2) which took 6 weeks to recover still has detectable asymmetry.

Injury to a very forward lateral sinus by bone chip occurred at the second gouge cut in one case. Bleeding from a tear 5 mm. long was stopped by packing and the operation was continued. The pack was removed in stages at three daily intervals under anæsthetic. This patient has an excellent hearing result.

The dura mater was slightly torn through in one case. I find, when using hammer and gouge, that even more care is required for the case with a well pneumatized but brittle bone than any other—even than the case with dense bone and a very low dura mater which can prove so difficult. No harm came from this incident.

In Case 52 an attempt was made to treat the exuberant granulations by tight packing[4] (under anæsthetic, with help of microscope). Her 25

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db. level had already been reduced by the granuloma. When the packing was removed she had renewed vertigo and further hearing loss; I had obviously made some mistake. The cavity has healed; hearing is worse still by bone and air, and vertigo has gradually disappeared in a period of months. (The vertigo was not very bad as she is a physical training instructress.) This patient had an allergic nose[3] and almost any remedy applied to the fenestration cavity appeared to increase the discharge and granuloma. Case 58 was also treated by packing and has lost her initial success on account of early closure.

The fenestra filled with blood in one case (Case 34), and probably two others. This resulted in hearing being worse.

Other more frequent mistakes have been slight tears of the flap, allowing one or two small fragments of bone to remain in the labyrinth, rupture of the labyrinthine vessels and partial detachment of the endosteum. Fortunately none of these has so far influenced the result of the operation.

Faulty indications. Case 11 was clearly not a case of conduction deafness. Case 13 (also late closure), 16 (good improvement from 95 db.), 18 (perforated drum), 34 (serous labyrinthitis) and 90 (œdema of flap; no result) had poor bone conduction with slope to the right. Case 75 deceived me on two occasions and an assistant on another. Before the operation it appeared that his left ear was slightly worse than the right at about 70 db. level. His bone conduction was at the 30 db. level. He appeared to have a good improvement post-operatively, but his fistula sign did not seem very active. He was very grateful. When he came for his three-month test it appeared that the operated ear was no better, but the unoperated ear had improved by 30 db. for each frequency. He is a very reticent type of individual and rather difficult to test. I suggest that with greater clinical acumen I might have detected that he was deceiving us.

Disadvantages

Otologists spend much of their time and energy in trying to dry up cases of chronic otitis media and it seems rather ironical that the fenestration operation, regarded by some as the "highlight of otology" should result so often in chronic otorrhœa. As most of my cases reside within a fairly small distance of the hospital I encourage them to see me if there is any difficulty. They have easy access to the out-patient clinic and usually attend if there is any trouble. No case has discharged profusely once the post-operative period was over. Apart from the presence of slight discharge the inconvenience has been occasional attacks of deafness and a sensation of blockage due to changes in the acoustics of the cavity. Some patients have developed small furuncles but there has been no case of serious infection—perichondritis or mastoiditis, for example. No case has died or suffered any other serious complication.

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Of the cases done more than a year ago, approximately 80 per cent. have dry ears at the time of writing as far as I know ; 10 per cent. I know are discharging slightly and 10 per cent. have recently done so. Of the 80 per cent. who are now likely to be dry, nearly half have at one time or another had a discharge continuously for months or occasionally had renewed trouble particularly with colds.

I cannot forget that old pus, epithelial debris and wax which collect in the fenestration cavity are separated from the labyrinth by a very thin layer of tissue, and feel compelled to continue treating these cavities if they discharge. This means frequent visits of the patient to the surgeon, perhaps from long distances or inconvenient places—a nuisance which at least may serve to emphasize the need for a simple home treatment of the discharging fenestration cavity and a better operative technique. Cases of labyrinthine suppuration due to neglect of the fenestration cavity should be reported. If these are few or do not occur it would appear unnecessary to carry out excessive treatment which may be waste of time both for the patient and the surgeon.[4] It is said that the discharge eventually dries up ; this has been on the whole my experience, but one of my worst cases healed in 6 weeks and was dry for 2 years before suppuration started.

Training of the Surgeon

Considerable experience of all types of mastoid surgery especially modified radical mastoid work encouraged me to try working under magnification. A large sterile loupe through which one can see with both eyes was mounted on a laboratory stand and underneath it was mounted a laryngeal mirror. A headlight was fixed to direct a narrow beam on the mirror and so into the wound. This simple apparatus, a dental drill and suction irrigation helped to emphasize the minutiae of aural surgery both of the cadaver and chronic otitis media. After further practice with the dissecting microscope and with Cawthorne's labyrinthectomy it was only a short step to fenestration. I was fortunate in the choice of the first case who had a wide meatus and well pneumatized mastoid. The operation took just over two hours and he has a good result. If I had encountered some of my later difficulties with this case, I should no doubt have hesitated for a considerable time before making a further attempt.

This is a very difficult operation—perhaps the most difficult of all. It is, however, only a technical procedure depending on anatomical variations ; unexpected pathology should be rare. The greatest anxiety is felt by the surgeon during the weeks following operation when it is only necessary to see the patient's face to realize that hearing has not yet returned. The surgery and management of these cases certainly taxes the resources of the E.N.T. surgeon who is busily engaged in all types of ear, nose and throat work, and it is reasonable to suppose that once more our speciality will be subdivided, if this operation proves to be the only

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treatment for chronic conductive deafness. If other simpler measures prove successful I shall at least be glad to have had the experience of fenestration, which has taught me so much more about aural surgery and diagnosis.

Other Points

Most patients experience relief or partial relief of tinnitus in the operated ear. Two cases have experienced increased tinnitus in the unoperated ear. Case 50 had previously developed tinnitus in the left ear immediately after the birth of one of her children. This tinnitus disappeared in the course of time. Later I operated on this left ear with a good result. Further tinnitus developed the day after operation in the unoperated ear and has continued for more than 14 months. Case 73 developed increased tinnitus in the unoperated ear immediately after she returned to her noisy occupation. This improved when she took a quieter job.

Case 3 developed acute rheumatism 4 months after operation. A physician, not being aware of her previous deafness, prescribed large doses of salicylates. She immediately became deaf again but recovered (and has maintained) her initial improvement when this course of treatment was discontinued.

The effect of pregnancy on the operated ear has been seen in six cases ; Case 4, Case 7 (two pregnancies), Case 15, and Case 40 experienced no alteration in their hearing. Case 24 became deaf for a day or two following parturition. Case 20 had become increasingly deaf after each of her first three pregnancies. She was operated on during her fourth pregnancy and lost some of her initial improvement after confinement. Her new level which has been maintained for two years is indicated in the table.

The fenestra is visible in at least seven cases either as a clear grey shadow or as a grey streak.

Only one case (21 and 61) has had both ears done. Hitherto I have adopted the view that, if the patient can manage all right, he should keep the unoperated ear in reserve unless it is deteriorating. Is this right ? If the operation were almost certain to be a success far better results would by obtained by operating on the better ear first instead of waiting for it to deteriorate (perhaps unnoticed) to an inoperable level.

Summary

1. The results of first 96 consecutive cases (including 49 done more than one and a half years ago) show at least 85 per cent. initial success with a satisfactory proportion of semi-permanent results (over two years).

2. The surgeon has been the cause of the failures.

3. The discharging fenestration cavity is a nuisance to both patient and surgeon.

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