PROBLEMS OF THE FENESTRATION OPERATION

By I. SIMSON HALL (Edinburgh)

Closure of the Fenestra

Failure in the operation means closure of the fenestra in the vast majority of cases, and I propose to discuss the causes of closure, the way in which it occurs, and the means by which we may perhaps be able to prevent it.

Closure is by bone or fibrous tissue ; with the modern techniques which have been evolved closure by bone is much less common than formerly, but it is not unknown even at the present time.

The statement is now heard that closure by bone does not occur, but that is not to say it will not occur if the patient is left long enough. It must be remembered that the majority of revisions are carried out within two years of the original operation, before bone has time to form in the fibrous tissue. We therefore do not know yet what is the ultimate fate of the fibrous tissue which may form in the fenestra. I should say that in all probability it goes on eventually to bone formation in most cases.

It has been assumed that the new bone grows out from the periosteum and endosteum and finally bridges the fenestra. I doubt whether this is frequent, particularly in those cases where enchondral bone is adequately exposed. I would hazard the opinion that the first stage is leakage of serum and blood from the flap, or bleeding from the unsealed endosteal vessels. This probably forms a coagulum under the flap and in this coagulum the fibrous tissue is produced.

Histological examination of material from a revision case shows the conversion of such a mass of fibrous tissue into bone, not by bone growing out from anywhere but by the appearance of isolated bone cells in the midst of the fibrous tissue. Obviously it is possible that this process may go on wherever blood clot is in contact with periosteum.

At one time I was of the opinion that the entry of blood into the labyrinth at the operation was probably the primary cause of closure, but a careful analysis of the operation notes of a large number of cases shows that this is extremely unlikely.

An analysis of operation notes revealed twelve cases in which blood in quantity was noted in the labyrinth at the end of the operation. Two

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cases only have deteriorated, one after two years, and one after eighteen months. While bleeding possibly plays a part, I believe that we have to look for other factors for the more frequent causes.

The Revision Operation

In all I have carried out the revision operation twenty-five times. The chief problem in the revision operation is the separation of the membranous canal from the fibrous tissue which occludes the fenestra, and I find it extremely difficult to accomplish this without damaging the membranous canal. While cases have been recorded where the membranous canal has been damaged and good hearing has been retained, I cannot feel that we should recommend that the canal should be opened and the membranous labyrinth ignored.

Professor Sourdille in one of his papers makes the remark that in carrying out the fenestration operation " one should always leave room for the revision ". He means by that, I believe, that as closure takes place, as a rule, from behind forwards, in carrying out the primary operation while it is essential to make a good opening over the labyrinth and over the roof of the vestibule, the extreme anterior position should be avoided. I am content to make a three to four millimetre opening which is entirely over the vestibule and not over the bony canal, and if I can leave an extent of vestibular roof intact anteriorly I am pleased, because it is in this region that one can most easily commence the revision operation.

In deciding the time of the revision, I prefer to postpone a revision as long as the patient is willing to wait. I dislike doing a revision inside a year and two years is not too long to wait.

I have noticed that a great many cases lose the improved hearing after a few months but retain some degree of fistula sign, and I have also noticed that although this hearing remains at a low level the fistula sign, as times goes on, reaches what one might call a "permanent level", that is, there is slight sensitivity on pressure but it does not completely disappear. I believe this means that the reparative process, having formed fibrous tissue or bone across the opening, has left a little space anteriorly where pressure can be exerted on the membranous labyrinth, and the fact that though the hearing has deteriorated the fistula symptom remains constant, means that the reparative process has now ceased, and further new bone formation will not immediately occur.

It is possible that in doing the revision operation early one operates on actively growing bone and fibrous tissue, and the same situation as occurred in the first instance is quite likely to occur in the second. Whereas if one has patience and is content to wait until nature has completed the repair, then the possibility of keeping that revised fenestra open is greater.

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I. Simson Hall

I do not think there is any necessity to dwell on the actual methods of doing the revision operation. Every case has its individual problem, and every operator probably has his own way of going to work.

In my own case I find the carborundum drill the most valuable instrument for clearing bone, and the Graefe knife indispensable for separating the membranous labyrinth from fibrous tissue or bone.

How far the original opening can be cleared depends upon the individual case and the degree of fibrosis within the labyrinth, but I believe it is better to be satisfied with a small opening rather than to run the grave risk of injuring the membranous labyrinth in attempting to get a large one.

It is my experience that the size of the opening has little influence upon the amount of hearing gain obtained. The only reason for making a large fenestra is that nature finds a large hole more difficult to close than a small one.

Of those twenty-five cases which I have revised only sixteen have been done more than eighteen months and are available for examination, and of these sixteen cases, eleven have been successful and five have been failures. The majority of the failures were due to the fenestra closing after a few weeks or months, but this percentage of success, I believe, fully justifies this operation.

I also believe that in quoting the final statistics of the fenestration operation the revision figures ought to be included. That is to say, the revision operation should not be regarded as something which may or may not be carried out later, but ought to be regarded as an integral part of the fenestration treatment, until we have solved the problem of closure.

The After-treatment of the Fenestration Cavity

I believe it is unlikely that any surgeon is completely free from this problem. Happily a discharging cavity is not incompatible with excellent hearing, and in many cases does not form a serious inconvenience. In my own cases I think that I have about 7-10 per cent. of cases which discharge for a period longer than three to six months, and the devising of some method whereby one can confidently dismiss a patient in a month's time secure in the knowledge that the ear will be dry within another month or so has been sought diligently for many years.

The causes of persistent discharge are many. Persistent fistula above the flap is due in many cases, I believe, to nose blowing before the flap has become properly adherent to the anterior attic wall, and is analogous to the eustachian catarrh of the radical mastoid cavity.

Another obvious reason for discharge is the cyst-like bone cell which is most frequently found in the region of the mastoid tip, sometimes also in the petrous angle. For this type of discharge I have yet found no certain cure, except possibly patience. For the first, elimination of

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nasopharyngeal sepsis and the treatment of discharging fistula with careful application of trichloracetic acid, rather after the manner of treating a perforation of the drum, has been successful in most cases.

Necrosis of bone or cartilage is responsible for some cases of discharge. Bone may be a detached bone chip which is left behind, necrosis of the cartilage may be due to crushing either with forceps or retractor, and I believe is very often due to the endeavour to obtain " elbow room " with the more restricted access of the endaural and other such routes.

When we have mentioned these obvious causes, there are many other cases in which we cannot locate anything which definitely causes the discharge. There is frequently a carpet of granulations or a pocket of granulations which refuses to clear up.

I have made observations on the bacteriology of these cases for some time, and I find that the majority of them are infected with organisms insensitive to the sulphonamides or to one or more of the antibiotics.

I also have the feeling, though it is a difficult thing to prove by statistics, that these cases are becoming more common.

I use penicillin as routine parenterally, not to give protection to the patients from sepsis, but to aid in cavity healing, and when packings and bandages have been discarded, chloromycetin is administered in powder form.

Before antibiotics were available, sulphonamide powders for the cavity treatment seemed to be the answer we required, but sensitivity to it developed, and it had to be abandoned. Then came penicillin in all manner of combinations, penicillin with glucose, sucrose, plasma, calcium phosphate, etc. On many occasions, in trying out these various types of drugs improvement seemed to have been obtained, but sooner or later something seemed to go wrong and the method was discarded in favour of a new idea.

At the moment I am on the point of considering whether the administration of penicillin should not be discontinued altogether. It is not required for the protection of the patient. I have proved in many hundreds of cases that asepsis is sufficient, and antisepsis in the form of penicillin cover is unnecessary. But after running, for a considerable time, a comparative series of cases in the various methods of skin grafting, I came to the conclusion that penicillin was of value in aiding skin grafts to take. With the increase of penicillin-insensitive infections the problem we have to consider is whether or not the routine administration of penicillin is producing these infections in greater number, and that we might possibly do better to discontinue its routine use.

Skin grafting has also been the subject of experiment in that I have been trying to ascertain whether primary skin grafting, that is, at operation, was superior to skin grafting carried out about one week later, and

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I had hoped to give you some figures, proving that one method or the other was better in a series of nearly 200 cases.

Primary skin grafting was fully worked out here in Edinburgh in pre-penicillin days by the late Dr. J. S. Fraser, but it was finally abandoned. When I came to study this problem, having the advantage of Dr. Fraser's experience, I explored fully the possibilities of secondary skin grafting, as it seemed to be a more physiological way of dealing with the problem. Almost ten years ago I published the results of a long series of cases which proved that in my hands at least, secondary skin grafting was superior to any other form of treatment of mastoid cavities. With the introduction of antibiotics it became necessary to explore this field again in view of the success which plastic surgeons had reported in grafting skin on bone.

I am sorry I cannot yet give definite details on my results because the problems which I have already mentioned to you, namely the prevalence of infections which are not sensitive to antibiotics, have introduced variables in the estimation of any such method. The simpler methods which were available in the earlier series I have quoted are not applicable to-day when one is dealing with smaller numbers. Experience is required in order to counterbalance the effect of intercurrent infections by insensitive organisms.

All I can say at the moment about this is that it seems to me still that secondary skin grafting is superior to primary skin grafting. The routine method which I prefer at the moment, is to protect the plastic flap with oil silk at operation, and fill the cavity with plastic sponge. This has the advantage of elastic pressure with non-adherence to the cavity. Five days to seven days later the pack is removed, and a Thiersch graft is cut from the skin of the leg. It is spread on vaselined oil silk so that it can be cut into pieces without curling, and it is then applied like miniature postage stamps to the cavity, which is again filled with plastic sponge for another five days. At the end of this time the sponge is removed together with the oil silk which carried the skin graft, and the cavity is powdered with whatever is being used at the time.

In the most favourable cases the ear is healed and dry in three weeks. In others the cavity suddenly becomes moist or shows granulation formation. Bacteriological study is immediately done in these cases, and almost invariably shows a penicillin-insensitive organism. A change of course is immediately made to whatever is the appropriate antibiotic, if one is obtainable. This as a rule brings the case under control.

One of the first things which our patients say to us when the fenestration operation is mentioned is, " What level of hearing will I obtain after the operation ? " Our answer to that question depends upon our knowledge and experience of the results in the varying types of cases which

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Mr. McKenzie has referred to in his paper.* The success or failure of the operation, from the patient's point of view, will very frequently depend upon what he or she has been led to expect by the surgeon.

The estimation of improvement after operation has always been a study of great interest, and various methods have been devised whereby we can arrive with moderate accuracy at what we can expect to happen when we operate upon a patient. The nearest attempt at scientific accuracy has been made by Carhart, who has devised a method of estimating the result of the operation by pre-corrected bone curve. This method demands an accurate calibration of the audiometer in that the output from the bone conductor bears a definite relationship to the air conduction curve.

This can be assured either by previous adjustment by the makers or by testing of a number of patients with pure nerve deafness and working out a constant relationship between air and bone conduction for the particular instrument being used. To this corrected bone curve certain other corrections are applied to compensate for mechanical damping in the middle ear.

Needless to say this testing, being dependent on bone conduction, requires silent conditions to be reliable. Under these circumstances it appears to give an accurate forecast of hearing after operation.

I have endeavoured to find out whether, under the conditions in which we have to carry out our tests, we could arrive at an equally accurate forecast of results of operation. In general I have been disappointed with the result. No pattern has emerged which is sufficiently definite to enable me to evolve a formula.

I found that in patients of moderate deafness the post-operative improvement corresponded to the pre-operative bone conduction curve in a number of cases, and I came to the conclusion that a formula would apply chiefly to those with a hearing loss of not greater than 50 decibels, and it also emerged that those which showed a fairly regular correspondence with the bone conduction curve were in the younger age group.

It is evident that those cases showing peculiarities of slight nerve deafness and other borderline conditions are very much more difficult to forecast than those with a regular flat or rising audiogram.

Another difficulty which emerges is the use of masking. Most authorities are agreed that in using bone conduction masking must be employed. It is also agreed that masking causes a diminution in the hearing in the ear opposite to that being masked, which is frequently something in the nature of 5-10 decibels if the 30 decibels masking tone is used in the good ear. We must remember therefore that in using masking, a correction should be applied for this also.

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This assumes that masking invariably produces the same amount of loss throughout the frequency range, but with masking in otosclerosis I believe we are facing a different problem when we are using the audiometer to estimate the value of the fenestration operation. The same probably holds true of air conduction, because a good many of our patients suffering from otosclerosis seem to be very much more sensitive to masking noise than are patients with other forms of middle-ear deafness. It was pointed out many years ago that masking may actually improve the hearing in the unmasked ear under ordinary conditions of testing.

I have been so impressed with the fallacies which appear to influence my results that where wide discrepancy occurs between the hearing of the two ears, I do two charts, one with and one without masking. This procedure frequently involves me in the necessity for doing several separate readings on the same patient, a very time-consuming occupation and one which I have found by experience cannot easily be delegated to technicians or to junior staff inexperienced in audiometry.

Difficulty may occur in the estimation of the probable effect of operation upon the second ear when one has carried out one successful operation. Where operation has caused considerable improvement the difference between the two ears may be such that masking should be applied when testing. Care must be taken in such cases, for if masking is applied a false impression will be gained of what the hearing really is in the unoperated ear and what can be gained by carrying out the operation.

In conclusion, one may say that with the equipment at present commonly employed, we do not have an accurate scientific method of estimating the results of the fenestration operation, and that in attempting to assess the level of hearing from the point of view of judging the result of the operation, masking should be employed with care and discretion, for if this is not done, the errors which it will introduce will more than counterbalance its advantages.

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