ON THE TECHNIQUE OF THE FENESTRATION OPERATION

By I. SIMSON HALL (Edinburgh)

It is impossible within the space of one short article to describe fully the technique of the fenestration operation and discuss the merits of the various modifications practised by operators in different countries. Therefore certain points only have been touched upon which seem to have afforded the greatest interest in discussion with many surgeons, and which have seemed to have been the subject of the keenest attention during demonstrations of the operation.

Approach Technique

A great deal has been written regarding the merits and demerits of methods of approach, and techniques have been named after certain ways of approaching the labyrinth. But it must be remembered that it is the making of the fenestra, and the keeping of that fenestra patent which in the end decides the success or otherwise of the operation and all else is of secondary importance. Therefore any technique of approach which renders it more difficult for an operator to reach the labyrinth and construct a satisfactory fenestra is not the technique which he should adopt. The easiest technique whereby the operator can work accurately and safely must remain the technique which is preferable for that particular operator in the fenestration operation.

The approach to the mastoid may be made through a variety of incisions. These approaches may be known as the post-auricular, end-aural and the trans-meatal. While the operator of great experience can adopt any of these techniques, those who are commencing the study of this operation would be well advised to adopt the method with which they are most familiar. If they have been trained initially to adopt the end-aural approach to the mastoid that will probably be the best approach for them. If on the other hand they have been accustomed to using the post-auricular technique there is no necessity for them to change the method and learn a new operation.

In the opinion of the writer this operation is no new technique nor is it in any way radically different from mastoid surgery in general. Many operators who can do a modified radical mastoid efficiently are not fitted to approach the apex of the petrous bone or to do a "Neumann" labyrinth operation. Similarly many can do these operations and yet are not fitted to do the "fenestration".
Fig. 1.
Temporal muscle and sheath exposed
FIG. 2.
Sheath split.
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This means that a surgeon undertaking fenestration work is practising the most advanced and delicate mastoid surgery, and without a background of general petrous bone surgery he cannot expect to get results until he is sufficiently experienced in this surgery. Therefore it will be a serious misfortune for the operation if experience in mastoid surgery has to be gained at the expense of badly done fenestration operations and possibly ruined hearing.

The most commonly used approaches are the "end-aural" and the "post-auricular". The former was popularized by Dr. Julius Lempert of New York, and is used to a very large extent in America, while in Britain and in Edinburgh in particular, the post-auricular approach has remained the method of choice.

It is agreed that as far as the fenestration operation is concerned either approach gives satisfactory access in expert hands, but demonstration and teaching is easier by the post-auricular route.

Post-Auricular Approach

The reason why the post-auricular method has been criticized as giving insufficient access and a difficult angle of approach must be that the principles of this method are not properly understood; if correctly used, it is possible to obtain a wider variety of angles of access than with any other. Also it has been criticized because it leaves an ugly scar. This again makes it obvious that those who have obtained such results have not been using the post-auricular approach as it should be used. The depressed posterior wound and the ugly scar should never occur, particularly in a non-suppurative case. The key to this method is the proper treatment of the temporal muscle, and the damage to the temporal muscle common in the past was responsible for the ugly results.

In using the post-auricular approach the incision should extend forward to a point vertically above the centre of the external auditory meatus or even a little further forward.

In the upper part, the incision is deepened down to the sheath of the temporal muscle; to bone in the lower part only (Fig. 1). Thereafter the sheath of the muscle is defined towards its anterior attachment and being defined, the sheath is split upwards in the length of the incision, leaving the muscle itself intact (Fig. 2). This renders it possible to stretch the muscle forward and obtain complete access to any part of the operative field (Fig. 3). When the retractors are removed the muscle will return to its previous position and the sheath will heal, thus ensuring that the auricle remains in its normal position, without any sagging, and without any sinking in of the retro-auricular tissues. This is a comparatively small point but it explains and meets the majority of the objections to the post-auricular incision. The larger part of the incision
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being within the hair-line it is less conspicuous after healing than any of
the more exposed incisions.

The advantages of the post-auricular incision to the teacher and
demonstrator are obvious, and what is even more important, the beginner
can be watched and advised much more closely than is possible with the
more restricted methods.

Bone Removal

The removal of bone is carried out either by gouge and mallet or by a
motor-driven burr according to choice and training, and little need be said
about the actual removal, except to point out that the only part of the
middle-ear cavity which will provide extra access in the difficult or narrow
ear cavity is the anterior or zygomatic angle. It is here that further
bone removal will enable the operator to obtain good access to the
horizontal canal. The question is frequently asked how much bone should
be removed and the answer is that the bone should be removed as far as
is necessary to obtain clear and free access to the whole of the ampullary
part of the horizontal canal.

How much requires to be removed will vary in different cases. In
some cases a very low dural plate may permit only a limited view of the
canal and it may be advisable to remove bone posteriorly to permit of a
flatter angle of the drill shank.

How much of the cell structure of the mastoid should be removed is a
matter of opinion. The author has experimented both with wide removal
and with very scanty removal. In the very wide removal trouble may be
encountered in getting a large bony cavity to heal. On the other hand if a
very small removal is undertaken and large cells left behind it has been
found in certain cases, that cyst formation within the cavity takes place,
owing to the lining of the cells secreting and forming a cyst. This in
time will give a great deal of trouble and healing will only take place after
fibrosis has occurred within the cyst. If large cells are encountered close
behind the posterior meatal wall it is probably wiser to remove part of the
posterior wall in order to obtain a fairly smooth cavity and so avoid
pocketing and cyst formation.

The Plastic Flap

Formation of the plastic flap is one of the most important steps in the
operation, and the author prefers to carry this out before commencing the
bonework. Occasionally it will be found when Henle’s spine is prominent
that it is of advantage to remove the spine with mallet and gouge, or drill,
before commencing the formation of the flap. The formation of the flap
is rendered very much easier if the meatus is opened into immediately and
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the flap constructed largely from the meatal side instead of attempting to form the flap entirely from the periosteal aspect. In this way a difficult portion of the operation can be carefully controlled, namely the freeing of the flap from the suture line in the roof of the external auditory meatus. The dense adhesions which may take place here may lead to tearing of the flap if separation is not done with very great care. Controlling the flap formation by sight both from the inside of the meatus and from the periosteal aspect enables the flap to be formed with speed and safety. The flap is removed from the bone and the bone is not removed from the flap.

It is also a mistake to attempt to take the flap right down to the edge of the drum at first, as in many cases the curvature of the external bony meatus makes it impossible to watch the point of the elevator. No movement in this operation should ever be done by feel alone; everything must be in clear sight and all separation carried out if necessary, under magnification.

The Meatal Opening

The opening should be of such a size that it is possible to inspect the whole cavity, so that after-treatment can be effectively carried out and accumulations of wax and debris removed.

The cartilage surrounding the opening should be protected as far as possible to prevent infection and necrosis. This can be done by removing a portion of cartilage surrounding the posterior part of the meatal opening, turning the skin inwards and stitching it in place. This gives an opening completely surrounded by skin and one which is particularly free from any tendency to contraction.

The Control of Bleeding

Throughout the operation there is no doubt that the motor driven burr tends to seal vessels more quickly than the hammer and gouge, but bleeding in most cases is not serious, and can be controlled at once either with the use of wax or by means of the polishing drill which should be always at hand and ready for use.

Formation of the Fenestra

For more than two years a technique has been taught and demonstrated in Edinburgh which has been named the "contact technique". As this method appears from experience to be standing the test of time and to have largely solved the problem of bone regeneration it is described here in detail.

The object of this method is to produce a fenestra which obtains a direct contact between flap and membranous canal and so prevents any chance of bone closure.
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There may be considerable variation in the anatomy of the lateral semi-circular canal. The chief variations affecting the operation are the thickness of bone overlying the canal, the tilt of the canal itself to the vertical, and the relationship of the facial nerve to the horizontal semi-circular canal. This last relationship frequently decides the exact location of the fenestra. If the facial nerve is on a level with, or as sometimes happens, above the level of the lumen of the canal it may be impossible to expose much of the ampulla of the canal without dissecting anteriorly below the level of the nerve. There is then a danger of leaving dead space under the flap which may be filled with blood clot leading to fibrosis or new bone formation. Under such circumstances dissection should be carried out: more to the upper side of the canal, and the bony canal itself should be thrown into relief slightly on its internal aspect rather than on the true vertex. Cancellous bone is first dissected rapidly off the canal and the area is smoothed off around the canal to ensure close application of the flap. The convexity of the canal is then flattened until the lumen of the canal can be identified as a faint bluish discoloration through the bone. The axis of the canal is thus defined and the exact location of the subsequent dissection is indicated. This portion of the roof of the horizontal canal forms the lid subsequently lifted off and is left untouched further by the drill. The bone is next thinned on the dural or upper side of the canal using the axis of the lumen as a guide.

The canal can be dissected up with accuracy and the thickness of bone removed with a fast-cutting, or a diamond burr. When the canal has been dissected on the upper part to a depth of approximately a millimetre to
Fig. 3.
Retractor inserted, and muscle stretched to expose the whole external auditory canal.
Fig. 5.
Fenestra completed.
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two millimetres, the same process is carried out on the side of the facial nerve. The Fallopian canal is in clear view all the time, and this dissection can be carried out with safety. A finishing burr or the smallest size of round carborundum is an appropriate instrument for this. No attempt should be made to expose the facial nerve or even to dissect very close to it. Rather than run any risk it is better to dissect more freely on the superior aspect of the canal, as has already been suggested.

The dissection is also carried round the anterior part of the roof of the vestibule. This portion is thinned until it is obvious that the ampulla is becoming more vertical within the vestibule. This is made evident by the fact that thinning forwards towards the facial nerve produces no extension of the blue colouration of the vestibule. This is the part of the dissection which is so frequently controlled by the height and proximity of the facial nerve (Fig. 4).

Dissection is carried on with finer and smaller burrs on both sides of the canal until the endosteum shines clearly through the bone. A small-sized drill of about one half to one millimetre is used for the final delicate dissection and the finishing burr is probably the best type for this part of the work.

The endosteum is exposed as accurately and completely as possible. Care must be taken not to break through the endosteum on the upper side as the thinning is, or should be, just at the level of the membranous canal. Frequently the canal lies in contact with the bone on the upper side and therefore any break through at this point will endanger the membranous labyrinth and if any endosteum-carrying bone is forced inwards it may be driven between the membranous tube and the upper wall of the bony canal and be extremely difficult to recover. On the side of the facial nerve, however, the "safe area" it may be termed, there is ample space for manipulation, and here after the bone is thinned right down to endosteum, the opening is finally made. The canal may be opened either with a fine drill or by a knife or a very fine hook. Which method is used is immaterial as the membranous canal is at a safe distance. The writer's preference is for the fine drill with which three or four depressions are made in the endosteum at intervals along the side of the canal. The canal must not be entered. Into one of these depressions the tip of an elevator is inserted and the lid is lifted off the canal. If this is done carefully and successfully the lid lifts off and a clean knife-like edge is left along the whole of the upper side. The only remaining work to be done is the clearing of a few shreds of endosteum from the side nearest to the facial nerve. No further breaking or scraping is necessary or desirable. When this is done accurately the membranous canal, including the posterior part of the ampullary enlargement, will be seen to be at the surface of the bone so that a flat instrument laid across the opening will just touch the canal. Thus contact with the overlying flap is assured (Fig. 5).
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The size of the final opening may vary in different cases, but it extends generally over that part of the membranous horizontal canal which lies over the body of the vestibule. The round opening of the ampulla into the utricle can be seen anteriorly, and the point of entry into the bony canal posteriorly. It does not seem to be of importance that the bony canal is opened, as experience with the early canal operation and the canal plus vestibule operation showed that closure of the canal opening occurred with great readiness while the vestibular part of the opening tended to remain patent.

The placing of the flap deserves considerable attention. In the first place haemostasis must be complete; the flap should be lifted and the fenestra inspected if necessary, and in the second place the fitting of the flap should be done with the greatest care, preferably under the microscope.

The flap is placed in contact with the bone and is fitted carefully all round, especially in the attic region. A small piece of green protective or rayon is placed over the flap itself, and a packing is placed on top of the material in order to keep the flap in contact with the bone and with the canal. Very firm packing should be avoided as this is liable to cause oedema and severe labyrinthine symptoms when the packing is removed at the first dressing.

The remainder of the wound is packed with some non-adherent substance such as optrex tulle or it may be lined with rayon as suggested by Shambaugh of Chicago, the packing being made inside the rayon envelope, and the wound closed as usual.

Post-Operative Treatment

The wound is left undisturbed for five days, when the first dressing is carried out and the packs are changed. It is left undisturbed for a further two days after which dressings and bandages are removed.

After-treatment by many forms of drugs have been tried. At present, powdering by penicillin-sulphamethazine powder has been found to give better results and induce fewer reactions than any other. In fact so few are the reactions with this form of dressing that it has been almost an inconvenience in that healing takes place slowly in certain cases.

No special precautions are taken to immobilize the patient; the patient is as a rule kept flat for the first day, but subsequently no restrictions are made and the patient is encouraged to get out of bed as soon as he is able.

During the convalescent period, exercises such as those suggested by Cooksey and Cawthorne are of great value in re-establishing compensation and helping the patient to get over initial disturbance of equilibrium.
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The time required for final healing varies greatly in individual cases. Some may heal in two to three weeks, but many need three months or more. The problems are similar to those of healing any mastoid cavity and if infection takes place they may tax the ingenuity of the most experienced.