

THE OPERATIVE TREATMENT OF CHRONIC MASTOID DISEASE

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MASTOID operations may be classified according to (1) what is removed, and (2) what is done with the resulting cavity in the temporal bone.

The objects of operation in order of importance are to make the patient safe by reducing his liability to intracranial complications, to retain and, if possible, improve his power of hearing, to rid him of an unpleasant and troublesome discharge and to leave, at the conclusion of operative treatment, as little deformity as possible.

(1) To attain these ends, and in particular the retention of hearing power, the less we interfere with the middle ear the better. Experience shows that removal of the incus does little harm to the hearing capacity, but that interference with the mucous membrane covering the round and oval windows is likely to result in considerable deterioration of hearing. Moreover, the decrease in hearing capacity is not infrequently progressive (C. H. Smith¹), particularly in those cases in which there has been a good deal of interference with the middle ear in the course of a radical mastoid operation. When, therefore, a considerable portion of the membrana tympani can be left *in situ* to protect the mucous membrane of the inner wall of the middle ear, the best results from the hearing point of view are likely to be obtained.

It is generally agreed that, if the mastoid is dealt with by operation, every cell which might possibly be diseased and which can be dealt with without undue risk of injury to important structures should be freely opened. What else may be removed is indicated in the following table :—

Removed.	Left <i>in situ</i> .	Nomenclature.
(1) Nothing, except mastoid cells.	Posterior bony wall of meatus, "bridge," outer attic wall, membrana tympani and ossicles.	<i>Simple</i> or cortical mastoid, associated with the name of Schwartz.
(2) Outer wall of attic, sometimes posterior bony wall of meatus, occasionally incus.	"Bridge," membrana tympani and ossicles.	<i>Conservative</i> mastoid, associated with the name of Küster, Zampal and Charles Heath.

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Removed.	Left <i>in situ</i> .	Nomenclature.
(3) Outer wall of attic, "bridge," posterior bony wall of meatus. Sometimes incus and, rarely, head of malleus.	Membrana tympani, usually ossicles.	<i>Attico-antrotomy</i> or modified radical mastoid, associated with the names of Siebenman, Bondy, etc.
(4) Outer wall of attic, posterior bony wall of meatus, "bridge," membrana tympani and ossicles.	Nothing.	<i>Radical</i> mastoid, sometimes associated with the name of Stacke.

In the first two of the above groups the tympanic ring with the attachment of the remains of the membrana tympani to it is left intact, but it is divided in the last two. The outer attic wall is removed in all but the simple mastoid operation. It is, however, doubtful how completely the outer attic wall was removed by Charles Heath² and the other surgeons who first described the conservative mastoid operation. Unfortunately the nomenclature is not yet unanimously agreed upon, the simple mastoid being occasionally described as the conservative, and the conservative sometimes as the modified radical.

In this paper I propose to speak of the four types of operation as the simple mastoid, conservative mastoid, attico-antrotomy, and radical mastoid.

(2) Before discussing these various operations, I will refer briefly to the methods of dealing with the resulting cavity formed by the opening-up of the mastoid antrum and cells. It may be allowed to granulate with or without secondary suture, or allowed to fill with blood-clot, or its obliteration may be undertaken by flaps of muscle or periosteum, or even some foreign substance such as B.I.P. In all but the simple operation, the mastoid cavity may be made to communicate with the external ear by some form of meatal flap and the mastoid grafted (together with the middle ear in the radical procedure), either at the time of operation or later.

In cases in which no meatal flap is cut (for the most part subacute cases) I generally close the wound, except for the lowest half-inch, and pack the mastoid cavity with gauze, which I change every second or third day, so that the wound granulates from above down. When I am in any doubt as to the condition of the meninges or lateral sinus, I am accustomed to leave the wound open and undertake secondary suture as soon as the middle ear has been shut off by granulations, and the results have been so satisfactory that I am adopting this method in an increasing number of cases.

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A detached muscle-graft from the rectus femoris or other muscle has been used, or a pedicled graft from the sternomastoid or temporal muscle. Kisch,³ who reports on the advantages of the temporal muscle-flap for the radical mastoid operation, and also attico-antrotomy, states that healing is usually complete in six weeks in radical cases. A periosteal flap has been used especially by G. J. Jenkins⁴ in this country, who has advised that a special strip should be pushed into the attic and Eustachian tube after the radical operation. O. Popper⁵ records the use of this method in thirty-three cases in children.

I cannot recall having filled the mastoid cavity with B.I.P. or other antiseptic substance, though I have often had occasion to remove these.

There is a tendency to take the view that the more unaltered we leave the external auditory meatus at the close of operation, the better ; and to attain this end muscle and periosteal grafts are extensively used in all types of mastoid operation. With this I entirely disagree. To avoid an ugly depressed scar behind the ear after a simple or cortical mastoid operation, a periosteal or muscle graft may have certain advantages, but for all other cases a meatal flap is, in my opinion, much to be preferred. The cosmetic disadvantages of a much enlarged external auditory meatus can be avoided if a properly planned flap is cut. I am accustomed to use the greater part of the posterior wall of the meatus as a flap which I bend upwards and retain in position by a very thin rubber tube in all mastoid operations, except the simple, and Mygind⁶ gives it as his opinion that relapses are less common after the radical operation when plastic meatal flaps are used, and suggests that the "without a plastic" radical operation should be abandoned. I am strongly in favour of the use of a meatal flap, as it makes the after-treatment, on which ultimate success so largely depends, very much easier. Moreover, it is very easy to end up with a contracted meatus when no flap is used, and this is also possible if the flap is of insufficient size or badly planned.

It is sometimes said that the cavity left as the result of a meatal-flap operation interferes with the power of hearing, but I know of no evidence for this statement.

A much more real objection, which applies to all meatal-flap operations, is that a cavity partly lined by scar epithelium is left, and that in this cavity epithelial débris and wax slowly

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collect and have to be removed at increasing intervals. When the patient is told of this at operation and has sufficient intelligence either to have his ear attended to regularly or keep the ear clean himself, no difficulties arise, but when the ear is neglected, ulceration may take place beneath the débris, and discharge recur. This in my opinion is the main, if not indeed the sole, objection to the flap operation.

My experience of Thiersch grafting has been, I regret to say, very limited, but those who practise it say that it is suitable for most cases except those with an exposed facial nerve or labyrinthitis (D. C. Cuning⁷).

Types of Operation

The Simple Mastoid Operation.—Turning next to the various mastoid operations and the indications for each, there can be no doubt that the simple mastoid, when it can be used, gives the best all-round result. It is obviously unsuitable when there is attic disease or cholesteatoma, or a very small or contracted meatus. It has no advantages when the hearing is completely destroyed, or there is caries of the posterior meatal wall. It is, in my opinion, the operation of choice for those cases in which, without marked changes in the middle ear, the hearing is slowly deteriorating as the result of definite, and perhaps increasing, bone destruction in the mastoid, as shown by the X-ray picture. It is, therefore, the best operation for relatively early cases of chronic mastoid disease. It has been pointed out that in many of these cases resolution can be accelerated by the enlargement of a small perforation of the membrana tympani at the time of operation, but I am afraid I have not taken advantage of this suggestion as often as I ought. I have had two or three cases in which the lower half of the membrana tympani has been completely destroyed, and the ear has dried up rapidly and completely after a simple mastoid operation.

The Conservative Mastoid Operation.—Two essentially different operations are included under the heading of conservative mastoid. In both, the outer attic wall is removed by cutting away bone either from within outwards (H. B. Blackwell⁸), or from without inwards (Voss⁹), but while in one the posterior bony wall is left intact, in the other it is completely removed and a posterior meatal flap is cut. Except

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that the removal of the outer attic wall makes it easier to be certain that the zygomatic mastoid cells are properly opened up, the first type (in which the posterior bony wall is left) appears to me to have no advantage over the simple mastoid operation. It is obviously unsuitable for cases with a marginal perforation or any appreciable destruction of bone, and for such cases the simple operation is equally useful.

When, however, the greater part of the posterior bony wall of the meatus is removed and the mastoid antrum thrown into a common cavity with the meatus, the conservative operation has, in my opinion, many and great advantages over the simple mastoid operation. In the first place the posterior meatal and zygomatic cells can be much more certainly exposed by it. Moreover, it is particularly useful when there is caries of the posterior meatal wall, when the meatus is contracted, whether as a result of a previous mastoid operation, exostoses or other conditions, and when, after a simple mastoid operation, the posterior wound will not heal, because the aditus fails to be shut off by granulations. It has the advantage that the posterior wound almost invariably heals by first intention—so that bandages can be left off within a fortnight—and, particularly, that the membrana tympani, aditus, attic, and antrum can be dealt with readily both at operation and at any time during healing—this, to my mind, is the greatest of its many advantages. Its only disadvantage is that a cavity is left in which ulceration may take place in an unintelligent individual. When the opening in the tympanic membrane is thought to be too small for free drainage, it can be enlarged. I have used this operation extensively since I was first shown how to do it by Mr. Charles Heath² nearly thirty years ago, and am satisfied that it is still of value.

Attico-antrotomy.—In attico-antrotomy not only is the posterior bony wall of the meatus removed, but the “bridge” as well, so that the membrana tympani, or as much of it as remains, is unsupported and unattached to the tympanic ring in its upper and posterior aspect. It is often necessary also to remove the incus and occasionally even the head of the malleus. This operation is replacing the radical mastoid in an increasing number of cases. Its chief advantage is that since the middle ear is but little interfered with, the hearing is in many cases unaffected and sometimes even improved. It is especially indicated in a patient with an aural discharge—

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which may have lasted a long time, and with an attic or posterior marginal perforation—and who has fairly good hearing in the affected ear. More especially should this operation be considered if the hearing on the other side is bad.

What are its principal contra-indications? I have carried out this operation a good many times in the presence of cholesteatoma and so far have had no occasion to regret it, and this would appear to be the general experience of surgeons.

To what extent is this operation justified in the presence of intracranial or other complications? When there is no perception of hearing on the affected side there can be no possible advantage in an attico-antrotomy, nor would I perform this operation in those rare cases (if they exist at all) in which a partially dead labyrinth is indicated by the caloric or other test, while some power of hearing remains. A labyrinthine fistula is also, in my opinion, a definite contra-indication, as also is facial paralysis.

When, however, the labyrinth appears healthy and the hearing on the affected side is of some value, I do not think that the existence of a cerebral or cerebellar abscess or lateral sinus thrombosis make the indications for a radical mastoid imperative, especially if the hearing on the other side is very defective.

The Radical Mastoid Operation.—Very little need be said about the *radical mastoid operation*. It is the operation we all do in the worst cases, when for instance there is little power of hearing, and the middle ear is much disorganized. It is also the operation of choice when there is a labyrinthine fistula or facial paralysis due to direct extension of inflammation. In tuberculous disease of the middle ear a radical mastoid operation will usually be required. While a radical mastoid will undoubtedly make a patient much safer, as far as intracranial complications are concerned, it does not always clear up the discharge. Moreover, the possibility of danger to the facial nerve, and of decreased power of hearing which may be progressive, has to be taken into account. It is especially on account of this last that the operation should be avoided whenever possible in children and young adults.

What should be done to the Eustachian tube in a radical mastoid operation? Should the mucous membrane be tucked in, in the form of a plug? (Kisch³.) Should the opening of the tube be curetted, or should it be left alone?

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Blackwell⁸ has suggested that the mucous membrane of the tube may grow out through the enlarged orifice after curettage and lead to a continuance of discharge. Personally, I am accustomed to curette the tube, but in some cases my curettage has not secured the desired result, and the tube has remained open. On one occasion I apparently pushed my curette into the internal carotid artery, for on its removal a jet of arterial blood shot half-way across the operating theatre. The bleeding was, however, stopped by tight plugging, and the patient fortunately made an uninterrupted recovery.

Douglas Guthrie¹⁰ states that in his view the radical mastoid operation should not be performed in those aged under 12, save in the presence of cholesteatoma, intracranial complications, or tuberculosis of the ear. He says that on account of the difficulty of closing the Eustachian tube, the middle ear becomes repeatedly reinfected and filled with granulations and the hearing greatly impaired, and my own experience, though much more limited, confirms this. Guthrie prefers the simple mastoid operation for children or, if this fails, attico-antrotomy.

Summary

To sum up : When the hearing is fair and the perforation central, a simple or conservative operation is indicated, the simple in the relatively early cases, and the conservative (with removal of the posterior bony wall) in the later cases and in those with meatal changes. When the perforation is marginal and the hearing good, an attico-antrotomy should be the operation of choice, but if the hearing is lost, it has no advantage over the radical mastoid operation.

Statistics

In conclusion it may be useful to inquire what can be learned statistically about the results of the various types of mastoid operation. Such results are, however, in no sense comparable, because we are not comparing like with like, since every surgeon selects his cases, reserving the radical operation for those in which there is the greatest destruction of the middle ear and usually also the greatest loss of hearing. Moreover, the statistics of different surgeons for the same operation are not

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always comparable, for with some, the criterion is the surgeon's own observations, and with others, the patients' statements.

Howarth and Bateman¹¹ in a recent and valuable contribution, report 43 per cent. of dry ears in eighty-three conservative mastoids. It is to be noted, however, that these were cases of chronic otorrhœa requiring operation taken almost entirely without selection.

In earlier reports from the Royal Infirmary, Edinburgh, conservative mastoid operations and attico-antrotomies were grouped together. But since 1928, thirty-seven operations of attico-antrotomy have been performed, and these are analysed by Bernard Carter.¹² A dry ear is reported in 65 per cent. of cases, improved hearing 43 per cent., hearing unchanged in 35 per cent., and worse in 22 per cent. The results of forty-four cases under the charge of Mr. J. D. Lithgow between 1933 and 1936 are recorded by J. F. Birrell¹³ with 82 per cent. of dry ears. J. Jessen of Copenhagen¹⁴ reports the results of seventy-one attico-antrotomies (with a dry ear in 58 per cent.), hearing improved in 40 per cent.; unchanged in 26 per cent.; and worse in 26 per cent.

Turning now to the results of the radical operation, J. S. Fraser,¹⁵ in an analysis of 422 cases, gives 42 per cent. of dry ears with a higher percentage in grafted cases. J. Jessen of Copenhagen¹⁴ reports 32 per cent. of dry ears, and L. White, Jr.¹⁶ 57 per cent., and approximately the same percentage whether the ear was grafted at the time of operation, later, or not at all. As regards hearing capacity, J. S. Fraser's cases between 1919 and 1928¹⁷ show:

	Improvement.	No change.	Worse.
In grafted cases ..	72%	14%	14%
In non-grafted cases	64%	11%	25%

J. J. Pressman¹⁸ as the result of analysis of 372 cases:

Improvement.	No change.	Worse.
35%	18%	47%

I am indebted to my colleagues, Mr. F. J. Cleminson and Mr. C. P. Wilson, for permission to make use of the records of all cases of chronic otorrhœa dealt with by mastoid operation at the Middlesex Hospital, during the last seven years. With the help of the Registrar, Mr. D. W. Ashcroft, I have tried to get in touch with all the 163 cases, but have not been entirely successful. Our results, together with those recorded by other

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surgeons as far as discharge and hearing capacity are concerned, may be summarized in the following table:—

Operation.	Reporter.	Ears dry.	HEARING.		
			Better.	Unchanged.	Worse.
<i>Simple mastoid</i>	Middlesex cases ..	%	%	%	%
<i>Conservative mastoid</i>	Howarth and Bateman ..	43	—	—	—
	Middlesex cases ..	65	34	—	66
<i>Attico-antrotomy</i>	Bernard Carter ..	65	43	35	22
	J. F. Birrell ..	82	—	—	—
	J. Jessen ..	58	40	26	26
	Middlesex cases ..	25	12	50	38
<i>Radical mastoid</i>	J. S. Fraser ..	42	72	14	14
		—	64	11	25
					grafted
					non-grafted
	J. Jessen ..	32	—	—	—
	L. White, Junr. ..	57	—	—	—
	J. J. Pressman ..	—	35	18	47
	Middlesex cases ..	46	31	38	31

As regards results in children, Guthrie¹⁹ in 1926 gave 67 per cent. of dry ears in simple mastoids, 62 per cent. in attico-antrotomy, 52 per cent. in radical mastoids, and N. Asherson²⁰ in 1932 reported 50 per cent. of dry ears in attico-antrotomies, and 54 per cent. in radical mastoid operations. Asherson's figures indicate also that the former operation gives a slightly better result as regards hearing.

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