

THE AQUEDUCT OF FALLOPIUS AND FACIAL PARALYSIS.

BY DAN MCKENZIE.

(Continued from p. 143.)

PART II: FACIAL PARALYSIS.

OPERATIVE TRAUMA OF THE FACIAL NERVE IN THE TEMPORAL BONE.

The frequency of facial paralysis from this cause seems to vary considerably with different operators, but it may be broadly stated that it is much less commonly inflicted to-day than it was even twenty years ago before the course of the nerve had been so closely studied and had become so widely known. And it is certainly less frequently seen in British than in Continental clinics.

Grunert, writing in 1896, reported 9 cases of facial paralysis and paresis in 309 complete operative exposures of the middle-ear spaces—that is to say, nearly 3 per cent. Brieger, in 1900, reported 9 cases of facial paralysis in 169 radical mastoids—that is, over 5 per cent. Stacke saw 3 cases with complete facial paralysis in 100 cases.

Modern British operators have practically excluded complete facial paralysis from the operation. With a personal experience of many radical mastoid, labyrinth, and brain operations I have not seen one case of complete permanent facial paralysis resulting from the operation, excluding, of course, cases which have proved fatal within a few days of operating.

It is necessary to add, however, that statistics such as these are misleading. We shall see later, for one thing, that trifling and evanescent paresis of the orbicularis palpebrarum is commoner than is generally supposed, while, for another thing, complete and permanent facial paralysis from operation is decidedly rare in any case. Furthermore, before any weight can be placed upon these figures we must make allowance for the fact that operators vary considerably in the view they take of the relative importance of the integrity of the facial nerve as compared with the removal of the disease. It frequently happens, especially with caries in and about the sinus tympani, that one is tempted to risk the paralysis in the effort to eradicate the disease. In this matter each case can only be judged on its merits, but unnecessary risk to the nerve is to be condemned.

Here we shall bring together what our studies of the anatomy have taught us regarding the position of the aqueductus Fallopii and its contained nerve in relation to the operative surgery of the ear and temporal bone.

In the adult the first skin incision of the mastoid operations behind the ear and the subsequent clearing of the mastoid process, whether the incision is made close to the auricle or further back through the hairy scalp, does not endanger the facial nerve in the soft parts after its exit from the stylo-mastoid foramen, as the incision is not carried any further forward than the tip of the mastoid process. Nor, when this incision is prolonged downwards into the neck in those rare cases of lateral sinus thrombosis in which the jugular bulb has to be opened up, does it come anywhere near the facial, since the nerve lies anterior to the oblique line joining the post-aural with the neck incision along the anterior border of the sterno-mastoid muscle—that is to say,

provided that the operator is careful not to carry the incision joining the two skin wounds unduly far forward.

Such is the state of matters in the adult. In the infant, on the other hand, until the growth of the mastoid and the meatal portions of the temporal bone leads to the covering in and protection of the stylo-mastoid foramen—that is to say, until the age of two years—if the lower end of the post-aural incision, or dissection, be carried as far down, relative to the pinna, as in the adult, then the nerve will be endangered near its exit from the foramen. It is to be remembered also that the tip of the mastoid, the landmark for the lower end of the incision, is either entirely absent, or is but slightly prominent in infancy and early childhood (Figs. 28, 30, and the skiagrams of the infantile bone). Thus if the operator relies for his lower landmark upon the feeling of a bony protuberance or fulness beneath the pinna at this age, he will be misled, and may sever the nerve before the operation on the bone is begun.

In the simple Schwartze operation the steps which involve the bone do not endanger the facial nerve so long as we remember the depth of the mastoid (vertical) segment of the nerve, together with its position relative to the posterior meatal wall. For this reason, before opening the mastoid process, in clearing the bone of its periosteum it is advisable to expose and define as our landmark the posterior wall of the meatus (Dundas Grant).

Attention has already been drawn to the need in this operation for care in curetting forwards towards the position of the Fallopian canal where a highly cellular mastoid has become diseased and broken down, as the cells occasionally reach as far forward as the vertical segment of the canal (see Fig. 11). And this warning should be particularly attended to when the mastoid disease is already associated with facial paralysis, in which case disease in those cells and in the bone bordering upon the canal may be the cause of the paralysis, and being softened, will be easily broken down with the curette to the prejudice of the nerve. At the same time, we must add that facial paralysis from disease attacking the mastoid segment of the nerve must be rare if we are to judge by the absence of allusion to it in the literature.

That is to say, in performing the simple Schwartze operation the nerve is, with even ordinary care, not exposed to operative injury. As a matter of fact, it is in performing the radical mastoid operation that danger is incurred.

First, in penetrating the upper part of the mastoid to reach the antrum, if the excavation be made at too low a level and carried too far into the bone, then the facial canal may be opened and the nerve injured by gouge, chisel or burr, in its vertical segment (*cf.* Figs. 3, 4, 8). But this is an error which only an inexperienced or careless operator would commit, and then only if the antrum is small and highly situated in relation to tympanum and meatus.

Secondly, after the antrum has been reached and opened behind, if the chisel is too heavily struck in breaking down the "bridge," it may be driven on and impinge upon the aqueduct in the tympanum just above or lateral to the oval window, and cutting through the papyraceous bony sheath of the nerve at this spot it may sever it entirely.

It is to prevent this happening that Stacke's or Grant's probe is inserted below the "bridge" before it is broken down. To the experienced operator, however, such protectors are unnecessary.

As a matter of fact, neither of these two accidents is common. Indeed, many otologists will go through a lifetime of operating and never see them. But there is a third way in which the nerve may be injured and that is common.

In the posterior part of the tympanic cavity, especially in and around the sinus tympanicus, granulations from caries of the bone frequently form, and the operator is therefore tempted to curette these regions, sometimes rather vigorously, with the result that the nerve passing down close behind this region is injured (see Figs. 1, 7, 11, 16, 21 and 45).

The fourth method in which the canal is endangered is when the posterior wall of the bony meatus is being planed down with the chisel

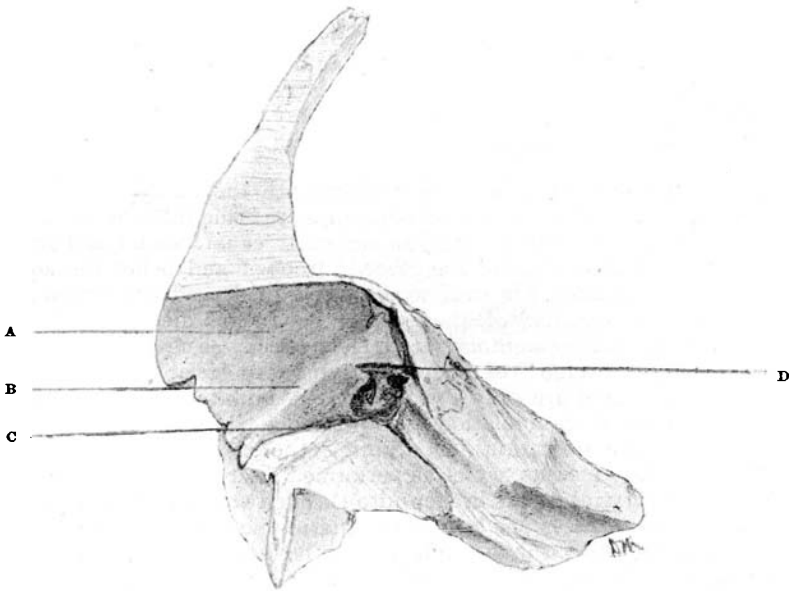


FIG. 45.—Sketch of the radical mastoid operation cavity in a bone operated on in life; viewed from the front. The roof of the cavities has been removed for illumination. A. The mastoid cavity. B. The "facial ridge" (the posterior meatal wall planed down). C. The floor of the bony meatus. D. Aqueductus Fallopii opened up in the tympanum; just below its outer end is the sinus tympani. (Right temporal, adult. The specimen is tilted.)

in order to expose the floor of the aditus and the posterior tympanic region (see Figs. 45 and 47).

Towards the outer end of the meatus the posterior meatal wall (the "facial ridge"), already partly removed in excavating the bone, may be shaved down to the level of the floor of the meatus, and if from this point a gradual elevation leading to the level of the floor of the aditus be left, the nerve will not be injured, as it lies lower than the floor of the aditus, descending vertically from that point as we have seen, so that the floor of the aditus may be taken as the limit of safety.

In thus shaving down the posterior wall a practical hint of Dundas

Grant's may be mentioned. The chisel may be used reversed so that the bevel at its point tends to plane out of, instead of into, the bone.

One occasionally hears it said that there is a "bulge" or prominence caused by the facial canal in the floor of the aditus. In none of my specimens did I find any such prominence, and the only bulge I have encountered in this neighbourhood is that of the external semicircular canal (confirmed by A. Cheatle—personal communication).

Hugh Jones's Line.—This landmark in the radical mastoid operation is described by Jones as follows: "If a plane be drawn from the prominence of the external semicircular canal to the highest point of the floor of the meatus, and parallel antero-posteriorly with the antro-tympanic axis, everything external to it may be freely removed, while everything within it must be treated with the greatest respect" (see Fig. 46).

In my specimens I have investigated this statement and it has stood the test. In no single instance, in adult bones, did the facial canal pass lateral to the plane of the Hugh Jones's line. Mr. Cheatle, with his large experience of temporal bone anatomy, agrees with this finding (personal communication).

In the "bridge operation" on the labyrinth the facial nerve is endangered. In this proceeding two openings are made into the labyrinth spaces, the one into the external semicircular canal behind and above the aqueductus Fallopii, and the other in front of and below the aqueduct into the cochlea, the oval window being enlarged downward and forward at the expense of the promontory. The distance between external canal and promontory, as we have already seen, gives sufficient room for the "bridge" of bone conveying the facial nerve, but the measurements here are only by millimetres, and the fine canal may easily be broken if manipulation is not very delicate.

Next, in the operation for draining the meninges through the internal auditory meatus, which is performed after labyrinthotomy, the internal auditory meatus is broken into through the modiolus (Fig. 26), and in doing so, unless one keeps low, and in the internal meatus near the floor of the canal, the facial nerve may be damaged, and this is particularly prone to happen if in the effort to ensure an adequate flow of cerebro-spinal fluid the canal be too freely curetted.

The facial nerve is also exposed to injury in operations on the jugular bulb as we have already seen. In order to prevent damage to the nerve in this operation Panse recommends that the Fallopian canal be opened up in its vertical segment and the nerve removed from it and raised out of the way of the operator. After the operation the nerve is left free, and although some paralysis may follow this manipulation it soon passes off. This author states that the nerve is very firmly adherent in its canal, and must be freed from it with a knife or the tenotome for the tensor tympani with the utmost care. The removal of the nerve stops short at the pyramidal bend lest stapes or external semicircular canal be injured.

All the foregoing operations involve an opening up and an exposure through the bone of the deeper structures in the ear, so that risk to the facial nerve is not surprising. But it is the fact, also, that the presence of the nerve, often insufficiently covered by bone, in the wall of the tympanic cavity, exposes it to danger even in simple manipulations

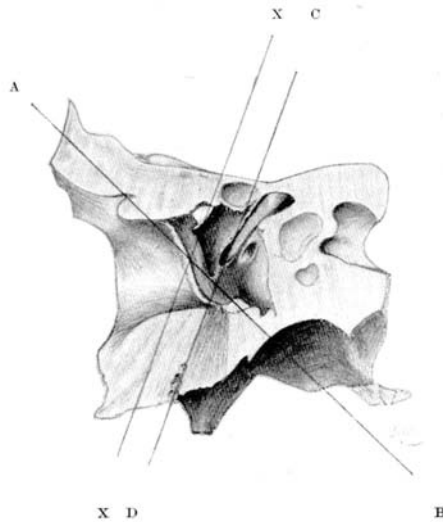


FIG. 46.—Hugh Jones's line. A.B. Line of membrana tympani. C.D. Line of vertical segment of the facial canal—the specimen is tilted and this line is unduly oblique. X.X. Hugh Jones's line. (Right temporal, adult.)

TO ILLUSTRATE DR. DAN MCKENZIE'S PAPER ON THE AQUEDUCT OF FALLOPIUS AND FACIAL PARALYSIS.

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carried on through the external meatus. In the operation of ossiculectomy, for example, for the cure of suppuration of the middle ear, or for the relief of deafness in chronic adhesive catarrh, facial paralysis is occasionally produced in the act of dislocating and removing the incus. I have myself seen one case, operated on elsewhere, which had but partially recovered, and several others have been reported. This operation is, however, practically obsolete nowadays.

Similarly, over-persistent efforts at removing foreign bodies through the meatus have induced permanent paralysis by wounding the Fallopian canal, and even such simple operations as snaring a polypus may, if the polypus is attached to the nerve, be followed by facial paralysis.

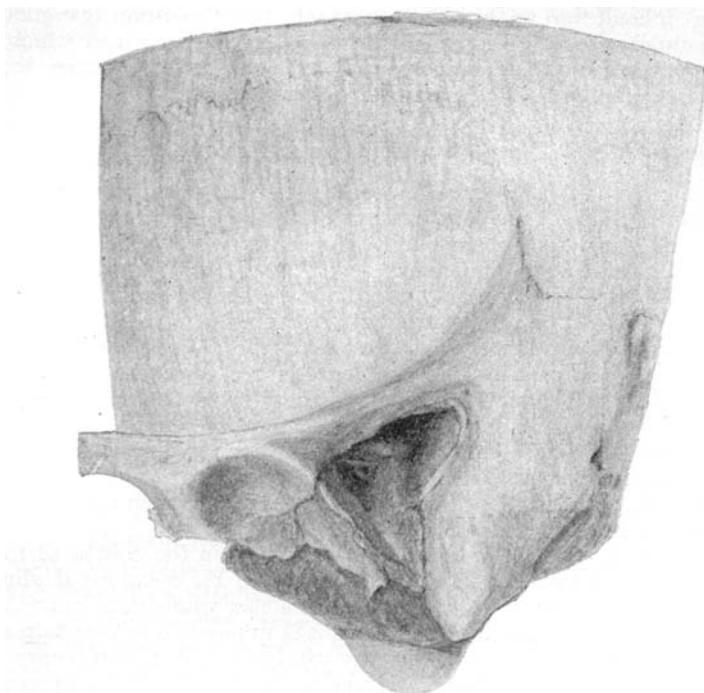


FIG. 47.—The bone cavity of the radical mastoid showing the bony meatus, the posterior meatal wall, the antrum, the external semicircular canal, the facial canal, and below it the oval window. (Left temporal bone, adult.)

It is perhaps unnecessary to say that in the event of such a sudden mishap, the radical mastoid ought to be performed at once and the lesion in the nerve sought for and remedied if possible (see later).

Facial Paralysis following Operation on the Gasserian Ganglion.

This is an infrequent complication of an infrequent operation. It may either be partial or complete, and is, when it occurs, "of uncertain duration." Harvey Cushing has suggested that it is not true paralysis but only a loss of movement due to the loss of the muscle sense which follows the destruction of the fifth nerve. But if this were the

cause the loss of movement would surely be constant, not occasional. Jonathan Hutchinson, on the other hand, thinks that it is "due to detachment of the dura mater from the upper surface of the petrous bone, and hence to blood getting through the small openings leading to the aqueductus Fallopii."

Evidently the mechanism of its production is not quite clear. But what probably happens is that in detaching the dura from the base of the skull as the operator is making his way in towards the Gasserian ganglion lying in its fossa in the front of the tip of the petrous, he drags upon the great superficial petrosal nerve with the dura about it, and so pulls and may conceivably tear the trunk of the parent nerve at the hiatus Fallopii. Indeed, in some of the specimens I have examined it would be difficult for an operator to reach the Gasserian ganglion without actually crossing the geniculate ganglion, the bone over which, always thin, is sometimes entirely wanting, and then, of course, the geniculate ganglion would be open to direct injury.

Diagnosis and Prognosis of Traumatic Facial Paralysis.

It is often possible to hazard a conjecture as to the nature of the injury and the cause of the paralysis by noting the time after the injury at which the paralysis appears, and by observing also its manner, and particularly its rate of development.

(1) If the paralysis appears immediately after the injury has been received—whether it be a bullet-wound, a fractured base, or an operative trauma—the presumption is that the nerve-trunk has been so gravely injured at the moment of the accident as to cause an immediate interruption of its conductivity, and the most usual character of this injury to the nerve is division of its trunk. This is not, of course, the sole lesion which produces instantaneous paralysis, since the transmitted impulse of a high-velocity bullet may induce physiological interruption, as may also the displacement of a fragment of bone in such a way as to exercise pressure upon the nerve.

In operating, the mishap may be suspected if in the course of the manipulation a chisel, *e. g.* in the vicinity of the Fallopian canal, slips and at the same moment the side of the face as a whole twitches. As the patient is under a general anæsthetic it is impossible to ascertain at the moment whether or not there is any paralysis. But if on recovery from the anæsthesia complete paralysis is present, then it may confidently be supposed that the accident has either severed the nerve, or has displaced a spicule of bone upon it so as to cause pressure paralysis.

In this type of paralysis, howsoever produced, unless it is possible by immediate operation to remove the cause, if the cause be removable, or unless it is possible to clear the severed ends of the nerve, and to bring them into permanent contact, the prognosis is not good. Experience shows, however, that it is not altogether hopeless. A certain amount of recovery is usual.

(2) If at the outset facial paralysis is definitely observed to be absent, and if no indication of any paralysis appears for from two to eight hours after the accident, and if in its development it shows, as it is likely to do, a progress which is only gradual, then the likelihood is that there has been confusion with the formation of hæmatoma. It is also probable, however, that a blood extravasation into the canal may

take place so rapidly as to induce paralysis instantaneous in its appearance, and it is in this way that we may explain those cases which suddenly develop after some excitement or violent emotion, such as fear.

The nerve fills the canal very fully, and obviously will be easily compressed between an effusion and the rigid bony walls, and this factor must be largely responsible for the frequency of facial paralysis.

(3) If no sign of paralysis appears until two or three days after the exposure to injury, then developing gradually, the diagnosis of neuritis may be made, and complete recovery anticipated in from three to six weeks. Quite frequently such cases never progress beyond the state of paresis, and sometimes indeed the defect of movement is so slight that it escapes observation (see later). These trifling cases recover entirely in a few days. I have recently seen a case in which the paralysis appeared for the first time six weeks after the operation—a Schwartz.

Treatment of Traumatic Facial Paralysis.

Facial paralysis from a fractured skull generally receives no treatment other than that for the general trauma and for any facial paralysis, but a case has recently been reported in which the ear was opened up and the nerve successfully relieved of the pressure of a fragment of bone (B. Agazzi).

When the nerve is divided in its canal in a war injury, the treatment will depend upon the general nature of the wound. If it is recent and the ends of the nerve can be identified they should be brought into contact, and perhaps sutured with very fine catgut passed through the sheath only and avoiding as far as possible the nerve-fibres. If the route of the missile can be followed up and is seen not to traverse the Fallopian canal, nor to cause fracture or splintering of the bone, no effort need be made to expose the nerve at least for several months, as the paralysis may be recovered from spontaneously.

When in the course of a mastoid operation the nerve is known to be or to have been divided in the canal by the chisel, an attempt should be made to expose it by removing the bone carefully and then to bring its severed ends into contact—a procedure which has been employed by Sydenham with success.

Suturing of the nerve-ends as they lie in the canal is out of the question, but, on the other hand, the canal will act as a bridge for the support and guidance of the sprouting nerve-fibres, provided that the cut ends of the nerve be brought into contact in the canal. For this reason the operative exposure of the nerve as outlined above will be called for in order not only to ensure that the ends are in contact, but also to relieve the nerve from the pressure, it may be, of extravasated blood, or of spicules of bone. The site of the traumatic lesion will probably be known to the operator if he has produced it, and will be found in one of the localities we have just enumerated. Otherwise its situation may be gathered from the type of paralysis present (see later).

These directions do not, of course, apply to facial paralysis which develops slowly after operation and is due to neuritis, etc. Such types may be left to Nature and asepsis.

It is important in all cases to obtain and to maintain as complete asepsis as possible.

(To be continued.)