

THE SURGICAL REPAIR OF THE SOUND-CONDUCTION APPARATUS*

WITH SPECIAL REFERENCE TO MOBILIZATION OF THE STAPES

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Deafness is possibly the commonest disability of mankind, affecting all races and ages. Yet until the past few decades it was an affliction for which little could be done. There was much truth in the cynicism that deafness could be divided into two classes—that due to wax, and the incurable.

The present position is that nerve or perceptive deafness still defies the best efforts at amelioration. In many cases hearing aids are able to give sufficient help to ensure social and economic rehabilitation but medical or surgical cure is still an improbable dream of the future.

Conductive or middle-ear deafness has, however, gradually succumbed to the efforts of generations of aural surgeons, to such an extent that a majority of such cases of deafness can be successfully treated by surgical means. The post-war years have seen great strides made in the surgical repair of defects of the mechanism of sound-conduction.

Conductive deafness falls largely into two groups, caused by either chronic infection or otosclerosis:

1. *Lesions caused by chronic infection*

This results in perforation of the ear drum or erosion of portion of the ossicular chain together with chronic inflammatory obstruction of the oval and round windows and the

Eustachian tube. As I have previously described in greater detail,¹ by means of microsurgical techniques called tympanoplasty the ossicular chain is reconstituted and granulations removed from the windows and Eustachian tube. The superficial epithelium is removed from the ear drum, exposing the fibrous matrix. This acts as a bed for the skin graft which is applied to cover the perforation and much of the operation cavity. One is able to restore an enclosed air-containing middle-ear cavity with an intact vibrating ear drum and a functioning sound-conducting mechanism. In 75% of cases it is possible to improve hearing to a serviceable level and often to near normal levels. The restoration of hearing is permanent and is accompanied by elimination of infection and closure of the perforation, resulting in a dry ear. One can foresee the time when tympanoplasties will constitute a very large proportion of surgical procedures for chronic otitis media. The technique requires special instruments and patience and ability to work for long periods under $\times 10$ or $\times 16$ magnification. Aural surgery owes a great debt to the pioneers of this technique from 1952 onwards—Professors Wullstein, Zöllner and Pietrantoni, at whose clinics I acquired first-hand information early last year.

2. *Otosclerotic Deafness*

This disease manifests itself by the deposition of new pathological bone in the labyrinth capsule. When this bone

* A paper presented at the South African Medical Congress, Durban, September 1957.

is laid down in the region of the oval window it joins the anterior edge of the foot-plate of the stapes to the margin of the oval window. This results in a lack of mobility of the stapes so that sound-waves are not freely transmitted to the inner ear. The deafness which is thereby caused is of course conductive, so that bone conduction is better than air conduction. The ear drum remains perfectly normal in appearance. As a rule, the disease first begins in adolescence, it is often familial and it is aggravated by pregnancy in 30% of cases in women. The process is progressive, so that a hearing aid gives decreasing help as the years go by.

The obvious point of attack was the foot-plate of the stapes. In 1876, Kessel attempted to restore the mobility of the foot-plate. He was followed by many others but early in this century these efforts were abandoned owing to unsatisfactory results. These were obviously due to lack of electronic audiometers for accurate tests of the hearing, poor illumination and magnification, and the absence of antibiotics to control infection and adhesions.

Subsequently Holmgren, Sourdille, and finally Lempert, devised methods of making a new oval window, the fenestra nov-ovalis, on the horizontal semicircular canal. This was covered with a free or attached skin graft. The sound-waves then by-passed the ear drum and ossicular chain and entered the inner ear directly through the new oval window. This procedure, fenestration, has been a most satisfactory operation. With improved technique serviceable hearing is restored in about 70% of cases. Few cases now relapse owing to closure of the fenestra. The operation, however, is quite a formidable one for the patient. He has to remain in hospital for over a week, suffers from giddiness for a couple of weeks, especially for the first few days, and has to attend for dressings for a period up to 4 weeks from the time of operation. Later the patient should not swim, should avoid sudden loud noises, and in some cases may have intermittent discharge from the operation cavity.

Rosen² revised the old discarded attack on the fixed stapedia foot-plate, using a transmeatal approach devised by Lempert³ to expose the middle-ear cavity. The basic Rosen stapes-mobilization technique has since been modified and is extensively used by otologists throughout the world. At the International Otological Congress in Washington in May 1957 no fewer than 28 papers described experiences with this technique.

My personal experience is limited to the period from May 1956, and at the time of writing constituted a series of 64 cases. I shall describe the technique and then discuss my results.

TECHNIQUE OF MOBILIZATION

The patient has an audiogram curve of hearing by air and bone conduction, and his hearing for the whispered or spoken voice is also ascertained.

One hour before operation the patient is given an injection of 100 mg. of pethidine with 1/150 gr. of scopolamine, varied according to build and other factors. Local anaesthesia is produced by an injection of less than 2 c.c. of 4% procaine with epinephrine by means of a cartridge-type dental syringe. The injection is made by inserting a fine needle down to bone in the posterior-superior part of the entrance of the external auditory meatus. One can observe the solution

infiltrating the skin of the meatus and finally the drum itself. A small supplementary injection is given postero-inferiorly.

From this stage one uses the Zeiss binocular operating microscope, operating through a wide-mouthed black aural speculum. An incision with a specially angled knife is made through the meatal skin from 5 o'clock (or 7 o'clock) to 12 o'clock, 5-6 mm. from the edge of the ear drum. The skin is carefully elevated forwards to the annulus tympanicus. The ear drum is then lifted out of the sulcus and turned forwards, exposing the posterior half of the middle ear. The chorda tympani nerve may have to be pushed out of the way but should not be severed. By means of a small curette or diamond drill a small portion of the bony margin may be removed postero-superiorly to give better visualization of the middle-ear structures. One can now see the round window niche, the long process of the incus and portion of the head of the stapes with the stapedius tendon extending backwards from the stapedia neck. Portions of the crura and the foot-plate of the stapes may be seen. At this stage I test the hearing for whispered or spoken voice.

Mobilization of the stapes is now attempted. A curved fenestration needle is applied to the anterior aspect of the head of the stapes and pulsating pressure is applied backwards in line with the axis of the stapedia foot-plate. This corresponds with the direction of the tendon of the stapedius muscle. The latter can easily be seen attached to the posterior aspect of the neck of the stapes. Often there is a sudden feeling of free mobility in the stapes, which had previously been firmly fixed. It will also be found that mobility is free in an infero-superior direction. If the hearing is tested there will be a dramatic improvement.

If mobility cannot be restored, the needle is applied to the head and pressure is made in an infero-superior direction, i.e. towards the vertex and also in the oblique axis. Lastly the needle may be used directly on to the anterior and inferior edge of the foot-plate of the stapes. Such manoeuvres may free an obstinately fixed stapedia foot-plate. A freely mobile stapes can be moved about like a cork floating in water. During manipulation of the stapes in successful cases, transmitted movement can be observed in fluid in the round-window niche.

When one is satisfied that the mobility achieved cannot be improved, blood is sucked out of the tympanum with a needle suction tip. The round-window niche is inspected and cleaned of adhesions, which are occasionally encountered. The drum with its attached cuff of meatal skin is replaced and gently kept in apposition to the meatal wall with small pieces of spongostan. The meatus is occluded with a light cotton-wool plug and a dressing applied over the ear. The patient is discharged from hospital on the following morning and given an oral antibiotic for the next 4 days. Nose-blowing and air travel are prohibited for 5 days.

Post-operative pain is unusual, whilst giddiness has not been experienced in any of my cases, except for a few hours after operation. A post-operative audiogram is obtained 5 weeks after operation.

Complications of Stapes Mobilization

Fracture of the crura may occur before the foot-plate is mobilized, resulting in failure of the operation. Dislocation of the incus is of no importance and is occasionally performed deliberately so that the mobilization needle can be applied

directly to the exposed external surface of the head of the stapes. If the incus is replaced in its normal position there are no harmful effects.

Transient facial paralysis has occurred in 2 cases, recovering completely within 8 hours. Such paralysis is due to infiltration of the facial nerve with the local anaesthetic solution, presumably along the chorda tympani. Perforation of the ear drum has occurred in some early cases, but has healed completely within the first week.

DISCUSSION OF RESULTS

In my opinion, in the present state of our knowledge of otosclerotic deafness, mobilization should be advised in all cases.

In early cases, with a hearing loss in the vicinity of 30 decibels, fenestration is not practical as the hearing improvement is too little to warrant such a formidable ordeal. Mobilization, however, can restore hearing to near the normal level, by means of what is an essentially minor operation. Advanced cases with secondary cochlear degeneration, have generally a poor prognosis with fenestration. A successful mobilization can offer hope of serviceable hearing with a negligible risk of further cochlear deafness.

If mobilization fails, fenestration can be performed within a few weeks. The operation is no more difficult than in

cases which have undergone no previous operative interference.

In one case, owing to the insistence of the patient, I performed a second mobilization after failure at the first attempt. The result was highly successful. This case required direct manipulation of the anterior edge of the foot-plate of the stapes.

It must be stressed, in conclusion, that the great majority of the successful cases have been easily mobilized. One of my best results was obtained in a case in which the operation lasted only 15 minutes.

RESULTS

Out of a total of 64 cases in which I have performed stapes mobilization, 22 cases have reached a hearing level of 30 decibels loss, or better, in all three frequencies of the speech-hearing range. An additional 5 cases have reached a level not lower than 35 decibels loss in one or two of these frequencies. Thus a total of 27 cases (42%) have had what can be regarded as a highly successful result. Finally, several cases not included in the above figures have shown improvement ranging from 17 to 27 decibels, but have not attained a level of 35 decibels loss.

Particulars of the 27 successful cases are given in the following table:

AUDIOMETER READINGS (DECIBELS LOSS)

Date of Operation 1956	Name	500 c/s		1,000 c/s		2,000 c/s		Average gain (decibels)
		pr.*	po.*	pr.	po.	pr.	po.	
20 Jun.	Mrs. J.	50	30	50	30	55	30	22
30 Oct.	Mast. A.H.	40	30	40	25	40	30	12
4 Dec.	Miss Z.J.	50	20	50	25	35	30	20
6 Dec.	Mrs. H.W.	45	25	45	25	35	25	17
1957								
23 Feb.	Mrs. J.E.W.	40	15	45	15	35	10	26
5 Mar.	Mr. T.G.W.	35	15	35	15	40	15	21
14 Mar.	Mrs. P.v.d.M.	35	10	40	15	45	20	25
16 Mar.	Mrs. J.F.W.	65	20	80	20	70	25	50
9 Apr.	Mrs. McD.	45	25	40	20	40	20	20
22 Apr.	Mrs. M.J.M.	55	25	60	30	55	15	35
25 Apr.	Mr. P.J.	40	20	35	20	30	15	17
30 Apr.	Mrs. D.F.	55	30	60	35	60	30	25
23 May	Mr. I.M.	35	20	45	25	40	30	15
13 Jun.	Mr. S.C.	50	20	45	20	60	20	30
13 Jun.	Mrs. B.T.	50	15	45	15	35	10	30
20 Jun.	Mr. J.B.	45	25	45	30	45	35	15
20 Jun.	Mrs. J.J.L.	50	30	55	35	55	30	20
9 Jul.	Mrs. M.v.N.	45	20	50	35	40	30	17
11 Jul.	Mrs. N.K.	45	15	55	25	50	20	30
22 Jul.	Mrs. E.J.B.	45	35	50	35	50	30	15
8 Aug.	Mr. A.M.B.	45	15	45	25	50	20	26
9 Aug.	Miss S.J. (second ear)	45	20	45	20	30	15	21
28 Sept.	Mrs. P.v.d.M. (second ear)	40	0	45	10	55	15	38
4 Oct.	Miss A.D.	35	30	40	30	40	25	10
15 Oct.	Mrs. V.S.	40	25	40	25	35	15	17
17 Oct.	Mrs. P.L.	40	20	45	20	35	20	20
24 Oct.	Mr. J.C.B.	45	20	50	30	40	20	21

* pr.—pre-operative. po.—post-operative.

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