The Journal of Laryngology and Otology

(*Founded in* 1887 *by* MORELL MACKENZIE *and* NORRIS WOLFENDEN)

May 1954

FENESTRATION—A CRITICAL SURVEY

By C. A. HUTCHINSON (Salisbury)

IN the course of the last twenty years fenestration has successfully established itself as a surgical procedure for the relief of impedance (conduction) deafness.

Pioneer otologists working simultaneously but independently in Sweden, France, America and Great Britain were responsible for its development. Their techniques and their armamentaria were at first widely different, but in the course of time have approximated more and more to a common standard until to-day the techniques are almost identical save for slight differences in the method of approach (i.e. transmeatal or postero-superior) while the instruments employed for the various steps in the procedure have also become practically standardized.

This fascinating operative procedure is being practised nowadays by an ever-increasing number of aural surgeons, many of whom employ either approach to suit the individual case. How odd then that there should still be disagreement as to:

(1) What constitutes a suitable patient.
(2) What indeed is to be regarded as a satisfactory result.
(3) What post-operative interval should elapse before the result is assessed.
(4) What should be taken into account when making the assessment, and
(5) The applicability of the operation.

In this article the writer will attempt to elaborate these five points and will give the results of an investigation which he has been carrying out

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

in the hopes of shedding a little light on the applicability of the operation under discussion.

(1) The Suitable Patient

It used to be considered that the ideal subject for fenestration was the young adult of either sex with deafness of comparatively recent onset, a good cochlear reserve and a hearing loss of 20 to 30 decibels over most of the speech frequencies; but these criteria alone are not always or even often adequate. Many other factors enter into the question and cannot be disregarded. Take that of sex for instance: this is of particular importance in the case of an otosclerotic, for in a woman the question of whether she is pregnant or whether or not she is likely to become so must be considered. As is well known, the otosclerotic disease process is apt to be particularly active during pregnancy with an obviously adverse effect on prognosis. It is therefore necessary to point out this fact to the patient before arriving at any decision as to whether or not to operate.

Again, the comparative youth and robustness of the patients may actually militate against success for, while admittedly in the younger patient the hearing centre's powers of recuperation are greater than in the case of a middle-aged subject, it is in the young that the pathological process is apt to be most active and osteogenesis most vigorous; so that either unsuspected foci elsewhere in the labyrinthine capsule may develop rapidly and give rise to a disappointing result in spite of a perfectly satisfactory patent fenestration or osteogenetic closure may occur with disastrous effect. Considerable discretion should therefore be exercised in accepting the young robust individual for operation.

The temperament and intelligence of the patient are further factors which have to be considered. Optimum results cannot be expected in the non-co-operative patient. During the post-operative period the fenestrated subject must be prepared to make considerable efforts to re-educate his or her own hearing centres and, if he or she is not prepared or not intelligent enough to do so, only partial success can result. The need for such co-operation should be carefully explained to the patient beforehand, and it is only when the surgeon is assured of its being forthcoming that the operation should be proceeded with.

Lastly, subjects with a worrying nature and those subject to undue nervous strain, either personal or the result of their professional work, are unlikely to do well and should be accepted with reluctance, since full co-operation is unlikely to be secured.

(2) The Satisfactory Result

What exactly do we mean by this term? It has been generally accepted that 30 decibels is the limit of hearing loss over the speech frequencies beyond which deafness becomes a serious social and economic

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

handicap, and that 2064 is the vital frequency for conversational speech. These therefore taken together serve as a valuable yardstick for assessing the result of any surgical procedure for the relief of deafness.

At one time it was the practice to accept only the ideal patient for operation. Now obviously it should be comparatively easy for any surgeon, one might almost say "however inexperienced", following this practice to secure a high percentage of excellent results—if by that we mean restoration to the patient of some 10 to 20 decibels of lost hearing over the majority of the speech frequencies, so that all come to lie above the 30 decibel level.

But how about the many unfortunates who, though in all other respects eminently suitable, do not come within the category of ideal patients (i.e. those when all is said and done in whom the hearing loss is so slight and the handicap so minimal that in some cases one is seriously tempted to wonder whether they really require operation at all)? Are the former to be denied operation simply and solely because of the risk of only partial or indifferent success, for that is what it amounts to? Surely it is just as important to the considerably deafened patient to have the hearing power raised over most of the speech frequencies to the neighbourhood of the 30 decibel level even though slightly below it, when at least he or she will hear the coarser sounds of every day life, as it is to the less deafened patient to have the hearing power raised to well above 30 decibels over the whole range! If therefore this degree of improvement has been secured by operation then that operation may be regarded as fairly successful.

Then again, it is equally a fair degree of operative success when the hearing level at the critical speech frequency of 2048 has been raised to near or above 30 decibels, though other frequencies show less improvement.

Again, if operation on a very deaf patient has resulted in a general levelling off of the hearing loss at a reasonable level over all speech frequencies, he or she will derive greater benefit from a hearing-aid and greater comfort in its use, so that this too should be regarded as at least a partially successful result.

Lastly, if, as sometimes happens, stabilization of the hearing loss without further deterioration has been secured by operation, then again such operation should surely be regarded as partially successful.

(3) When Should the Result be Assessed?

It is a well-known truism that "nothing succeeds like success", and this must surely be the reason for some of the extravagant claims made for this operation. At the same time it should be borne in mind that nothing is so likely to bring an operative procedure for the relief of deafness into discredit as to make premature extravagant claims for it, only to

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

have such claims rendered void by subsequent deterioration of the regained hearing within the space of a year or two to a level approximately as low as, or possibly even lower than, the pre-operative one.

A year or two ago the writer engaged a new secretary who had previously worked for a fenestrator elsewhere: she stated that the surgeon in question had told her that *all* his fenestrations were successful. In response to the writer's expression of no little surprise and to his question as to when his colleague had made this remarkable claim, the reply was, "Oh, he used to come back and tell me that after each operation had been done." Could anything be more absurd? Any experienced fenestrator knows that on the average peak post-operative hearing is not reached until at least six months since operation while many cases continue to improve up to a year post-operatively and a few even longer than this. Then again, 83 per cent. of cases which undergo osteogenetic closure do so during the course of the first post-operative year, while the remaining 17 per cent. do so during the second post-operative year. Accordingly an accurate and honest assessment of whether a fenestration is a success or not can only be made provided the operator waits to make even a preliminary attempt at prognosis till the end of the first post-operative year, when there is a reasonable chance of the regained hearing as shown audiometrically being retained; and does not make the final assessment until the end of the second post-operative year, since the degree of regained hearing shown by an audiogram taken at that time will probably be retained for at least many years.

To wait like this is obviously irksome and trying to the patience of both patient and operator, but at least such a cautious assessment will save all concerned from the sad disillusionment which premature over-optimism must frequently bring in its train.

(4) How to Assess Results

There is considerable difference of opinion as to how to make this assessment. Some surgeons record the actual pre- and post-operative levels at each frequency; others merely record the number of decibels gained at each frequency; yet others record the average percentage of hearing regained for the whole range; while finally others sub-divide their results into somewhat arbitrary groups, such as "very good, good, fair and failure" while leaving one by no means clear as to how such groups are defined. Practically all ignore the question of the relation of the post-operative level to the important 30 decibel level or the vital 2048 frequency.

The writer is well aware that he is here treading on very controversial ground but, for what it is worth, gives it as his considered opinion that all such methods of recording and assessment moreover fail in that they omit

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

to take note of what has been happening in the case of the un-operated ear and therefore do not give a true record of the effect of the operation on the combined hearing which, when all is said and done, is a by no means unimportant point. He himself accordingly tries to obtain an overall picture of the result in each case by recording the gain or loss at each frequency, the average gain or loss in each ear and in the combined ears, the pre-operative and post-operative 2048 level in both ears, and then, as judged by the two years standard, classifies his cases in accordance with the following assessment scale—still somewhat arbitrary perhaps and possibly not adequately covering every type of case, but at least clear and having the sub-divisions precisely demarcated:

Excellent Very Good Good	Post-operative 2048 level, 30 to 40 decibels in one or other ear and average improvement of 10 decibels or more in one or other ear.
Fair	Post-operative 2048 level, 30 to 40 decibels in one or other ear and average improvement of 5 to 10 decibels in one or other ear.
Indifferent	Post-operative 2048 level, 40 to 50 decibels in one or other ear and average improvement of 10 decibels or more in one or other ear.
Poor	Post-operative 2048 level, 40 to 50 decibels in one or other ear. No or minimal improvement in one or other ear.
Bad	Post-operative 2048 level, 50 or more decibels in one or other ear. No improvement or actual loss in one or other ear.

Such an assessment scale is possibly a somewhat severe one but any surgeon employing it and adhering to the two years standard who can claim between 50 and 60 per cent. of successes has every right to be considered a good fenestrator.

(5) Applicability of the Operation

As has already been stated, it was formerly the practice only to accept ideal patients for operation, in fact some surgeons still adhere to this rule; but, as was pointed out, there are many deaf individuals who, though in all other respects eminently suitable, are no longer young adults, have been deaf for several years, or have a hearing loss of considerably greater degree than the ideal 20 to 30 decibels. Furthermore it has been the custom to regard cases of otosclerosis alone as being suitable for fenestration at all.

The writer was somewhat startled a little time ago to come across the following statements by a distinguished colleague (Cawthorne, 1951-52): "Nowadays a diagnosis of otosclerosis is made much more frequently than formerly, and it is hoped that euphemisms such as catarrhal deafness will rapidly recede into a well-deserved obscurity. . . .

"The pendulum has now swung the other way and a diagnosis of otosclerosis is sometimes applied to a case of deafness in which none of the classical features of that disease is present; in the hope that it will be considered acceptable for surgical treatment.

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

C. A. Hutchinson

"Of recent years the diagnosis of otosclerosis has, in the absence of histological evidence of the disease, been subject to the qualifying adjective 'clinical'. With the exception of the relatively few instances in which foci of otosclerotic bone are found in fragments of bone removed at operation such evidence is available only after death.

"It is now generally appreciated, thanks to the outstanding work of Guild (1944) that foci of otosclerotic bone are often found in the bony capsule of the labyrinth without giving any ante-mortem clues of their existence (q.v.) and this important observation shows that histological otosclerosis, provided it does not impede the movement of the stapes in the oval window, does not give any clinical evidence of its presence. Nevertheless, once the stapes is fixed, the clinical picture is rarely (un) mistakable, and it hardly seems necessary to wait for death before venturing on a diagnosis of plain unqualified otosclerosis.

"In this review, therefore, the term otosclerosis has been applied to cases of deafness, primarily conductive and usually progressive, for which no other cause was found in the auditory or upper respiratory tracts. The classical triad of Bezold (progressive conduction deafness with family history and normal auditory apparatus) was present in many cases, though in some it was modified by underlying internal ear changes."

Now in the writer's opinion such a diagnostic doctrine is definitely retrograde. Anyone with any experience of medicine in the Services will remember how the all too frequent diagnosis of P.U.O. (Pyrexia of Unknown Origin) was made use of to cover a multitude of slipshod diagnostic sins. That great teacher of therapeutics Sir Robert Hutchison once remarked that "sound therapy is dependent on accurate and meticulous diagnosis", and if we accept this truism we must deprecate any suggestion that we should employ a vague term such as "clinical otosclerosis" without bothering to establish which particular type of impedance deafness is actually present in the patient.

Though it is true that histological proof of the presence of otosclerotic bone is rarely available ante-mortem, yet a study of carefully taken radiograms of the labyrinth regions, employing the special angles described by the writer in the *Journal of Laryngology and Otology* (Hutchinson, 1946) will almost invariably reveal, save in the very early cases, varying but definite sclerosis in the labyrinthine capsule when compared with radiograms of individuals who are not the victims of otosclerosis.

The writer accordingly prefers, unless there be strong evidence to the contrary, only to accept as instances of true otosclerosis cases presenting the Bezold triad and radiological evidence of such sclerosis. Cases, on the other hand, with absent family history of deafness, sclerotic sometimes scarred tympanic membranes, blocked eustachian tubes, recurrent attacks of nasopharyngeal or middle-ear catarrh, or a history of previous mastoiditis, and no radiological evidence of sclerosis in the

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

labyrinthine capsule, he classifies as chronic adhesive process. The two conditions may obviously occasionally coincide.

Audiograms again have definite diagnostic value in that steep drops in the bone conduction curve in the region of the higher frequencies indicate nerve involvement either by otosclerotic foci in the region of the spiral ganglion or by fortuitous virus disease.

The above system of differential diagnosis has been employed throughout the following series to classify the cases under the various headings.

It was accordingly considered that an investigation into the applicability of the operation to at least some of such unideal patients and to other forms of impedance deafness than otosclerosis, might serve a useful purpose.

It was patently obvious at the outset that if one hoped to arrive at conclusions of any practical value, no useful purpose would be served by employing a series of handpicked "ideal" cases, but that one would have to collect a consecutive series showing varying ages, degrees of severity, duration of deafness, etc.; that moreover it was essential only to include cases which could have all investigatory details completed in every respect, who were prepared to co-operate fully and were willing, no matter where they lived, to attend for post-operative follow-up and audiometry for a full further period of at least two years.

Now it is one thing to induce a patient who is an "ideal" case, who will probably get a satisfactory result and who lives reasonably near at hand, to go on coming to you for two years post-operatively; it is a very different thing to secure similar co-operation from a patient who is a poor or possibly hopeless case for operation, who is certain to have a poor if not bad result, and who may live at a considerable distance: but, while it has taken a long time to collect a suitable series, the writer has been very gratified to find that of the whole series of 89 cases only fifteen failed "to stay the course" and have had to be excluded from consideration, though in some cases showing quite reasonable results, on account of incomplete details, refusal to co-operate or compulsory departure overseas for an indefinite period; the remaining seventy-four cases form a consecutive series.

The various forms of deafness included in this investigation (all of whom with one exception come under the category of impedance deafness) are otosclerosis, chronic adhesive process, Paget's disease with deafness, mixed otosclerosis and nerve deafness, mixed chronic adhesive process and nerve deafness, and mixed otosclerosis and chronic adhesive process.

Inter alia, the questions of age, duration of deafness and pre-operative 2048 levels were examined with a view to ascertaining what are the limits for each which should be taken into account when deciding whether or not to accept any particular patient for operation.

The two years' standard was adopted throughout and the assessment was made in accordance with the scheme outlined above: for clarity's sake

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

the summarized percentage results are given here. The detailed records of all cases for each form of impedance deafness, etc., are given in Appendix I, details as to Assessment in Appendix II, and details as to age, duration of deafness and pre-operative 2048 levels in Appendix III.

SUMMARIZED PERCENTAGE RESULTS

(*a*) *Otosclerosis:*	Total 23		
Satisfactory results	13	i.e.	56·5%
(*b*) *Chronic Adhesive Process:*	Total 33		
Satisfactory results	24	i.e.	72·7%
(*c*) *Paget's Disease with Deafness:*	Total 1		
Satisfactory results	0	i.e.	0%
(*d*) *Otosclerosis and Nerve Deafness:*	Total 8		
Satisfactory results	1	i.e.	12·5%
(*e*) *Chronic Adhesive Process and Nerve Deafness:*	Total 3		
Satisfactory results	0	i.e.	0%
(*f*) *Otosclerosis and Chronic Adhesive Process:*	Total 6		
Satisfactory result	1	i.e.	16·7%

Let us examine exactly what these results expressed in percentages amount to. It should be remembered that we are dealing with a consecutive series of whom few indeed were "ideal" cases.

(*a*) Out of twenty-three pure otosclerosis cases a satisfactory result was obtained in 56·5 per cent. Fifty appears to be the limit for age, and 77 per cent. of satisfactory results were obtained in those under the age of 40: 15 years appears to be the limit for duration of deafness and 58 per cent. of satisfactory results occurred in those whose deafness was of less than five years' duration. Fifty decibels appears to be the average 2048 limit for pre-operative hearing loss, but in 31 per cent. of satisfactory results the hearing loss was greater than this.

(*b*) Out of thirty-three pure chronic adhesive process cases a satisfactory result was obtained in 72·7 per cent. Fifty appears to be the limit for age, and 63 per cent. of satisfactory results were obtained in those under the age of 40: 15 years appears to be the average limit for duration of deafness, but on the other hand in 29 per cent. of satisfactory results the deafness had existed for 15 to 30 years. Sixty decibels appears to be the average 2048 limit for pre-operative hearing loss, but in 33·3 per cent. of satisfactory results the hearing loss had been greater than this.

(*c*) In the one case of Paget's disease with deafness (nerve deafness) the result was 100 per cent. bad and neither age, duration of deafness nor pre-operative 2048 level appear to have any particular bearing.

(*d*) Out of eight cases of mixed otosclerosis and nerve deafness a satisfactory result was obtained in 12·5 per cent. Thirty appears to be the limit for age: 5 years is apparently the limit for duration of deafness and

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

even then the chance is a very slender one: one satisfactory result was obtained in a case where the pre-operative 2048 level was over 50 decibels (65), but probably the limit is in the region of 30 decibels and even so the prospect of a satisfactory result is very poor.

(*e*) Out of three cases of mixed chronic adhesive process and nerve deafness the results were 100 per cent. bad and neither age, duration of deafness nor pre-operative 2048 level apparently have any particular bearing.

(*f*) Out of six cases of mixed otosclerosis and chronic adhesive process a satisfactory result was obtained in 16·7 per cent. Forty appears to be the limit for age: 10 years is probably the average limit for duration of deafness, but even so the chance is a very slender one. It is true, however, that the successful case recorded had deafness of thirty-five years' duration but the probability is that this was a solitary fortuitous instance: 50 decibels is the probable pre-operative 2048 limit.

Conclusions

What conclusions then can we draw from the above investigation?

Firstly, that contrary to views so far held there is, as a matter of fact, a considerably greater chance of a satisfactory result in cases of chronic adhesive process deafness than there is in cases of otosclerosis.

Secondly, that the chance of success is infinitely greater when dealing with a pure case of either of these two conditions than when dealing with a case where there is either mixed otosclerosis and nerve deafness, chronic adhesive process and nerve deafness, or mixed otosclerosis and chronic adhesive process.

Thirdly, that in cases of Paget's disease with deafness, where the deafness is almost certainly due to nerve involvement, and in cases of chronic adhesive process with nerve deafness, the prognosis is 100 per cent. bad and therefore sufferers from these conditions should not be subjected to operation at all.

Fourthly, that in cases of mixed otosclerosis and nerve deafness, and mixed otosclerosis and chronic adhesive process, the chance of success is very small, so that they should be accepted for operation with reluctance and only after explaining to the patient the poor prognosis and on his or her insistence.

Fifthly, that in cases of pure otosclerosis and pure chronic adhesive process, age, duration of deafness and pre-operative 2048 level have a very definite bearing on prognosis.

Sixthly, that the limits imposed in the past for accepting patients for operation were considerably narrower than appears from this investigation to be necessary and that in point of fact cases can be accepted for operation as follows:

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

(*a*) Otosclerosis—patients should be under the age of 50, with duration of deafness preferably under five years and with pre-operative 2048 level of 50 decibels or less.

(*b*) Chronic adhesive process—patients should be under the age of 50 with duration of deafness under fifteen years and with a pre-operative 2048 level of 60 decibels or less.

Lastly, that there is obviously far greater scope for the fenestration operation than was formerly considered to be the case and that, provided the above suggested limits are adhered to, not only may this valuable operative procedure be made available with a reasonable prospect of success to a considerably wider range of sufferers from deafness than was formerly supposed, but, thanks to improvements in technique, the percentage of satisfactory results is considerably higher nowadays than when the procedure was in its infancy.

Bibliography

Cawthorne, T. E. (1951-52) *Acta Otolaryng.* (*Stockh.*), **40**, 160.
Hutchinson, C. A. (1946) *J. Laryng.*, **61**, 573.

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

APPENDIX I

Analysis of Cases

A. OTOSCLEROSIS

No.	Sex	Age	Duration (years)	Gains or losses at the various frequencies										Average gains or losses			2048 levels				Time since Operation (years)	Remarks
				Operated ear					Unoperated ear					Operated ear	Unoperated ear	Combined ears	Operated ear		Unoperated ear			
				256	512	1024	2048	4096	256	512	1024	2048	4096				Pre-op.	Post-op.	Pre-op.	Post-op.		
8	M.	33	5	20	25	30	15	20	10	10	10	0	5	22	7	14	65	50	65	65	3	
13	F.	23	8	30	15	5	−30	−25	20	20	0	0	−15	−1	5	2	45	75	35	50	3	
16	M.	32	11	15	20	5	15	10	−15	10	−5	−5	10	13	1	7	45	30	30	35	2½	
17	M.	48	9	20	35	35	0	−10	10	10	−5	5	0	16	4	10	25	25	40	35	2	
18	M.	30	5-6	−15	10	5	−10	−15	5	0	−15	0	0	−5	−2	−3	20	30	30	40	2	
21	F.	23	½	10	15	0	10	15	5	10	−15	−5	0	10	−1	4	45	35	35	40	2½	
23	F.	34	16	10	25	5	0	0	15	20	5	−5	5	8	8	8	35	35	25	30	2	
24	M.	48	20	30	35	20	0	5	−5	5	−5	−25	−20	18	−10	4	40	40	40	65	2	
29	F.	28	7	25	20	10	5	15	0	5	5	5	35	15	10	12	65	60	70	65	2	
32	F.	39	18	10	10	10	0	10	5	10	5	0	35	8	11	9	40	40	45	45	2	
34	M.	25	10	30	5	15	15	5	30	20	5	5	20	14	16	15	55	40	50	45	2	
38	F.	17	2	30	40	25	20	0	45	30	40	40	30	23	37	30	45	25	40	0	4	
51	F.	33	8-9	−25	−35	−60	−50	out	5	−10	0	−15	−10	−34	−6	−20	30	80	25	40	2	
57	F.	17	1½	75	75	75	75	65	70	65	80	70	75	73	72	72	85	10	80	10	2	
59	F.	37	10	10	15	0	−5	35	−20	−15	20	20	10	11	3	7	20	25	40	20	2	
61	M.	20	6	0	−15	−5	−25	−15	10	0	−5	5	10	−12	4	−4	50	75	45	40	2	
66	F.	15	2	−25	−20	−10	−15	−15	0	0	0	0	5	−17	1	−8	60	75	30	30	2	
70	F.	14	1	15	10	0	15	10	20	10	5	5	5	10	9	9	35	20	15	10	2	
72	F.	22	8	−25	−15	−5	−20	−25	−15	−5	5	15	−5	−18	−1	−9	50	70	45	30	2	
74	M.	46	1	30	25	15	10	0	−5	5	10	0	0	16	2	10	70	60	15	15	2	
75	F.	36	½	0	5	25	15	20	−5	5	−15	−20	−30	13	−13	0	50	35	5	25	2	
82	M.	51	23	0	−5	−20	−10	out	0	0	−10	−10	−10	−7	−6	−6	65	75	40	50	2	
83	M.	45	10	−30	−20	−20	−25	out	−10	0	0	−5	0	−19	−3	−11	55	80	45	50	2	

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

B. CHRONIC PROCESS

ANALYSIS OF CASES

No.	Sex	Age	Duration (years)	Gains or losses at the various frequencies										Average gains or losses			2048 levels				Time since Operation (years	Remarks
				Operated ear					Unoperated ear					Operated ear	Unoperated ear	Combined ears	Operated ear		Unoperated ear			
				256	512	1024	2048	4096	256	512	1024	2048	4096				Pre-op.	Post-op.	Pre-op.	Post-op.		
5	M.	33	15	40	50	40	25	10	5	5	20	5	5	33	8	20	55	30	45	40	2	
6	M.	33	6	15	15	10	20	15	0	5	5	10	30	15	10	12	50	30	35	25	2	
22	F.	41	27	35	40	40	35	20	0	5	20	10	0	34	7	20	70	35	75	65	2½	
25	F.	37	12	−10	0	5	−15	−30	15	5	5	5	10	−10	8	−1	85	100	35	30	2	
27	F.	40	25	10	15	25	5	0	5	15	30	15	20	11	17	14	50	45	45	30	2	
30	M.	42	15	35	10	15	20	20	35	30	15	20	25	20	25	22	75	55	30	10	2	
35	F.	31	2-3	25	45	20	15	0	30	25	25	5	10	21	19	20	45	30	30	25	2	
42	M.	34	25	35	15	5	30	40	15	10	0	0	25	25	10	17	50	20	25	25	2	
43	F.	46	2	35	30	30	20	−5	25	25	25	20	15	22	22	22	45	25	15	−5	2	
44	M.	46	15	5	−5	−5	−5	−10	5	0	5	0	15	−4	5	0	40	45	40	40	2	
46	F.	36	10	10	15	10	15	10	0	10	0	−5	−15	12	−2	5	45	30	40	45	2	
47	M.	19	5	25	15	5	−10	0	−5	0	10	10	15	7	6	6	35	45	35	25	2	
49	M.	47	15	10	15	15	10	20	−30	−10	−5	−5	20	14	−6	4	35	25	30	35	2	
50	F.	19	1	−35	−15	−25	−20	−30	25	10	0	5	5	−25	9	−8	20	40	15	10	2	
53	F.	48	40	−15	−10	−15	−5	−5	−10	−5	−5	−10	5	−10	−5	−7	55	60	30	40	2	
55	M.	9	3	0	0	5	5	30	15	5	15	5	20	8	12	10	85	80	20	15	2	
58	F.	50	14	−5	10	15	35	25	−20	−10	−15	0	10	16	−7	4	55	20	45	45	2	
60	F.	26	6	−45	−45	−35	−50	−50	10	15	20	35	30	−45	22	−12	25	75	40	5	2	
62	F.	27	3	5	15	15	5	−5	15	−5	10	0	5	7	5	6	35	30	35	35	2	
63	F.	37	8	10	5	15	35	0	−10	0	15	10	0	13	3	8	60	25	5	−5	2	
65	F.	43	30	5	−15	0	10	−10	−5	−10	5	10	−20	−2	−4	−3	50	40	50	40	2	
67	M.	41	10	−20	−15	−5	25	0	5	15	10	35	40	−3	21	9	65	40	60	25	2	
68	F.	48	½	−10	40	25	−5	−15	0	10	10	5	5	7	6	6	65	70	5	0	2	
71	M.	57	20	−35	−30	−20	−30	−25	−5	−5	0	−5	−5	−28	−4	−16	50	80	45	50	2	
78	F.	30	13	20	10	15	20	−30	0	−15	5	5	−5	7	−2	2	45	25	40	35	2	
79	M.	21	¼	20	−5	−15	15	5	−5	−5	−5	0	0	4	−3	0	60	45	−5	−5	2	
80	M.	13	3	−15	0	5	5	−15	−5	−5	0	10	5	−4	1	−2	60	55	0	−10	2	
81	F.	23	3	5	15	15	0	15	0	10	0	10	15	10	7	8	25	25	5	−5	2	
84	F.	16	5	5	20	40	35	55	−10	25	25	−30	−25	31	−3	14	60	25	45	75	2	
85	F.	44	30	10	15	0	5	10	5	−10	0	0	−10	8	−3	2	65	60	35	35	2	
86	F.	38	19	−30	−20	−10	−25	−25	−20	−10	−10	−15	5	−22	−10	−16	35	60	30	45	2	
87	F.	34	5	−5	−15	−25	−30	−15	0	−5	0	10	5	−18	2	−8	35	65	40	10	2	
89	F.	46	15	−5	−5	−5	out	−35	−5	15	20	10	20	−10	12	1	65	out	70	60	2	

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

C. PAGET'S DISEASE WITH DEAFNESS

ANALYSIS OF CASES

No.	Sex	Age	Duration (years)	Gains or losses at the various frequencies										Average gains or losses			2048 levels				Time since Operation (years)	Remarks
				Operated ear					Unoperated ear								Operated ear		Unoperated ear			
				256	512	1024	2048	4096	256	512	1024	2048	4096	Operated ear	Unoperated ear	Combined ears	Pre-op.	Post-op.	Pre-op.	Post-op.		
52	M.	53	25	−15	−25	−30	5	−10	0	−15	−15	−10	−20	−15	−12	−13	80	75	55	65	2	
D. OTOSCLEROSIS AND NERVE DEAFNESS																						
10	F.	41	21	20	−10	out	out	out	10	0	−5	−20	−10	2	−5	−2	75	out	75	95	3	
14	M.	32	15	−5	−10	15	−10	−25	30	15	5	−15	−30	−7	1	−3	90	100	75	90	2	
15	F.	23	2	20	20	20	5	−10	15	20	25	45	35	11	28	19	65	60	85	40	2½	
19	F.	42	23	−10	−5	−5	−30	−5	−5	15	−5	0	15	−11	4	−4	40	70	60	60	2	
20	F.	27	6	−20	−10	0	−15	5	−10	0	−15	0	0	−8	−5	−6	65	80	70	70	3	
36	F.	45	24	−15	−25	−35	out	out	5	5	10	0	40	−15	12	−2	75	out	80	80	2	
41	F.	46	14	5	0	−5	15	0	10	5	0	15	35	3	13	8	95	80	85	70	2	
45	M.	33	16	25	20	25	−5	20	10	15	15	0	out	17	8	12	85	90	out	out	2	
E. CHRONIC ADHESIVE PROCESS AND NERVE DEAFNESS																						
31	F.	34	9	−5	−15	−15	5	20	20	10	−5	−5	30	−2	10	4	90	85	70	75	2½	
37	M.	49	24	20	−15	out	out	out	−20	−5	−10	−15	−10	1	−8	−4	60	out	70	85	2	
77	F.	21	21	−35	−25	out	out	−30	out	−30	−20	out	−5	−17	−11	−14	50	out	75	out	2	
F. OTOSCLEROSIS AND CHRONIC ADHESIVE PROCESS																						
11	F.	45	35	15	15	20	15	−5	0	−10	−5	0	5	12	−2	5	50	35	50	50	2½	
12	F.	34	11	−10	15	15	20	15	10	0	5	5	15	11	7	9	90	70	70	65	2	
33	F.	37	26	5	5	5	−10	20	−10	−15	−10	5	0	5	−6	−1	80	90	55	50	3	
39	F.	42	20	−5	−20	5	5	−45	10	0	5	5	0	−12	4	−4	55	50	45	40	2	
54	M.	34	5	0	−5	−5	−30	−40	−25	−45	−55	−75	−75	−16	−55	−35	60	90	50	95	2	
69	M.	38	23	−20	−30	−35	−40	−45	−5	−15	−5	0	0	−34	−5	−19	30	70	40	40	2	

C. A. Hutchinson

APPENDIX II

Assessment Details

(A) otosclerosis .. .. Total 23

Pre-operative

Deafness of less than 5 years	.. ..	7	
,, ,, ,, 10 ,,	.. ..	15	
2048 level in operated ear 45 decibels or less	.. .. ..	12	

Post-operative

2048 level 30 decibels in one or other ear	.. .. ..	12	i.e.	52·2%
,, ,, 35 ,, ,, ,, ,,	.. .. ..	1	,,	4·3%
,, ,, 40 ,, ,, ,, ,,	.. .. ..	5	,,	21·7%
i.e. ,, ,, 40-30 ,, ,, ,, ,,	.. .. ..	18	,,	78·2%
Average Improvement 10 decibels or more:	operated ear ..	13	i.e.	56·5%
,, ,, 10 ,, ,,	unoperated ear	1	,,	4·3%
i.e. ,, ,, 10 ,, ,,	in one or other ear	14	,,	60·8%

Assessment

Good	12	Satisfactory
Fair	1	Satisfactory
Indifferent ..	1	
Poor	0	
Bad	9	
	23	

Satisfactory result therefore	13	i.e.	56·5%

(B) chronic adhesive process .. .. Total 33

Pre-operative

Deafness of less than 5 years	.. ..	9	
,, ,, ,, 10 ,,	.. ..	15	
2048 level in operated ear 45 decibels or less	.. .. ..	13	

Post-operative

2048 level 30 decibels in one or other ear	.. .. ..	25	i.e.	75·8%
,, ,, 35 ,, ,, ,, ,,	.. .. ..	2	,,	6·1%
,, ,, 40 ,, ,, ,, ,,	.. .. ..	3	,,	9·1%
i.e. ,, ,, 40-30 ,, ,, ,, ,,	.. .. ..	30	,,	91·0%
Average Improvement 10 decibels or more:	operated ear ..	14	i.e.	42·4%
,, ,, 10 ,, ,,	unoperated ear	10	,,	30·3%
i.e. ,, ,, 10 ,, ,,	in one or other ear	24	,,	72·7%

Assessment

Good	17	Satisfactory
Fair ..	7	Satisfactory
Indifferent ..	0	
Poor	1	
Bad	8	
	33	

Satisfactory result therefore	24	i.e.	72·7%

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

(C) PAGET'S DISEASE WITH DEAFNESS .. .. Total 1

Pre-operative

Deafness of less than 5 years										0	
,, ,, ,, 10 ,, ...										0	
2048 level in operated ear 45 decibels or less										0	

Post-operative

2048 level 30 decibels in one or other ear											0	i.e.	0%
,, ,, 35 ,, ,, ,, ,, ...											0		0%
,, ,, 40 ,, ,, ,, ,, ...											0	,,	0%
i.e. ,, ,, 40-30 ,, ,, ,, ,, ...											0	,,	0%
Average improvement 10 decibels or more: operated ear ..											0	i.e.	0%
,, ,, 10 ,, ,, unoperated ear ..											0	,,	0%
i.e. ,, ,, 10 ,, ,, in one or other ear											0	,,	0%

Assessment

Good ..	0	Satisfactory
Fair	0	
Indifferent ..	0	
Poor	0	
Bad	1	
	1	

Satisfactory result therefore											0	i.e.	0%
Bad result therefore													100%

(D) OTOSCLEROSIS AND NERVE DEAFNESS .. .. Total 8

Pre-operative

Deafness of less than 5 years										1	
,, ,, ,, 10 ,, ...										2	
2048 level in operated ear 45 decibels or less										1	

Post-operative

2048 level 30 decibels in one or other ear											0	i.e.	0%
,, ,, 35 ,, ,, ,, ,, ...											0	,,	0%
,, ,, 40 ,, ,, ,, ,, ...											1	,,	12·5%
i.e. ,, ,, 40-30 ,, ,, ,, ,, ...											1	,,	12·5%
Average Improvement 10 decibels or more: operated ear ..											1	i.e.	12·5%
,, ,, 10 ,, ,, unoperated ear											1	,,	12·5%
i.e. ,, ,, 10 ,, ,, in one or other ear											2	,,	25 %

Assessment

Good ..	1	Satisfactory
Fair	0	
Indifferent ..	0	
Poor	1	
Bad	6	
	8	

Satisfactory result therefore											1	i.e.	12·5%

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

(E) CHRONIC ADHESIVE PROCESS AND NERVE DEAFNESS Total 3

Pre-operative

Deafness of less than 5 years		0
,, ,, ,, 10 ,,		1
2048 level in operated ear 45 decibels or less		0

Post-operative

2048 level 30 decibels in one or other ear	0	i.e.	0%
,, ,, 35 ,, ,, ,, ,,	0	,,	0%
,, ,, 40 ,, ,, ,, ,,	0	,,	0%
i.e. ,, ,, 40-30 ,, ,, ,, ,,	0	,,	0%
Average Improvement 10 decibels or more: operated ear	0	i.e.	0%
,, ,, 10 ,, ,, unoperated ear	0	,,	0%
i.e. ,, ,, 10 ,, ,, in one or other ear	0	,,	0%

Assessment

Good	0	Satisfactory
Fair	0	
Indifferent	0	
Poor	0	
Bad	3	
	3	

Satisfactory result therefore	0	i.e.	0%
Bad result therefore			100%

(F) OTOSCLEROSIS AND CHRONIC ADHESIVE PROCESS Total 6

Pre-operative

Deafness of less than 5 years	0
,, ,, ,, 10 ,,	1
2048 level in operated ear 45 decibels or less	1

Post-operative

2048 level 30 decibels in one or other ear	0	i.e.	0%
,, ,, 35 ,, ,, ,, ,,	1	,,	16·7%
,, ,, 40 ,, ,, ,, ,,	2	,,	33·3%
i.e. ,, ,, 40-30 ,, ,, ,, ,,	3		50%
Average Improvement 10 decibels or more: operated ear	2	i.e.	33·3%
,, ,, 10 ,, ,, unoperated ear	0	,,	0%
i.e. ,, ,, 10 ,, ,, in one or other ear	2	,,	33·3%

Assessment

Good	1	Satisfactory
Fair	0	
Indifferent	0	
Poor	1	
Bad	4	
	6	

Satisfactory result therefore	1	i.e.	16·7%

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press

APPENDIX III

Summarized Results as Regards Age, Duration of Deafness and Pre-Operative 2048 level

Ages

	Satisfactory		Unsatisfactory	
	Under 50	Over 50	Under 50	Over 50
Otosclerosis (23)	13 (10 under 40)	Nil	9 (7 under 40)	1
Chronic adhesive process (33)	23 (15 under 40) (7 under 30)	1	8 (4 under 40)	1
Paget's disease with Deafness (1)	0	0	0	1
Otosclerosis and nerve deafness (8)	1 (1 under 30)	0	7 (3 under 40) (1 under 30)	0
Chronic adhesive process and nerve deafness (3)	0	0	3 (2 under 40)	0
Otosclerosis and chronic adhesive process (6)	1 (1 under 40)	0	5 (4 under 40)	0

Duration of Deafness

	Satisfactory		Unsatisfactory	
	Under 15	Over 15	Under 15	Over 15
Otosclerosis (23)	12 (7 under 5)	1	9 (1 under 5)	1
Chronic adhesive process (33)	17 (6 under 5)	7	4 (3 under 5)	5
Paget's disease with deafness (1)	0	0	0	1
Otosclerosis and nerve deafness (8)	1 (1 under 5)	0	2	5
Chronic adhesive process and nerve deafness (3)	0	0	1	2
Otosclerosis and chronic adhesive process (6)	0	1 (over 30)	2	3

Pre-operative 2048 Level

	Satisfactory		Unsatisfactory	
	Under 50	Over 50	Under 50	Over 50
Otosclerosis (23)	9	4	3	7
	Under 60	Over 60	Under 60	Over 60
Chronic adhesive process (33)	16	8	5	4
	Under 50	Over 50	Under 50	Over 50
Paget's disease with deafness (1)	0	0	0	1
Otosclerosis and nerve deafness (8)	0	1	1	6
Chronic adhesive process and nerve deafness (3)	0	0	0	3
Otosclerosis and chronic adhesive process (6)	0	1	1	4

https://doi.org/10.1017/S0022215100049677 Published online by Cambridge University Press