

Use of hearing aids by patients with closed mastoid cavity

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Abstract

Twenty-five patients who had undergone a closed-cavity tympanomastoidectomy in our Unit and wore a hearing aid in the operated ear were reviewed, and information was recorded on the use of the aid, and the patients' impression about it. The information obtained was analysed and compared with similar data from 39 hearing aid users of similar age with no history of ear surgery. Eighty per cent of the patients with a closed mastoid cavity were satisfied with the aid, and no significant difference was found between the two groups regarding the impression about the aid (chi square 3.06, $p = 0.08$), or the problems with it, which, in most of the cases, were related to several changes of mould (chi square 2.19, $p = 0.13$). The various recorded parameters are discussed, and it is concluded that the patients with a closed mastoid cavity can tolerate a hearing aid in the operated ear at least as well as the control subjects with no ear surgery.

Introduction

The combined approach tympano-mastoidectomy, has proven in this Department to be an efficient surgical procedure for eradication of cholesteatoma, whilst preserving or restoring the normal anatomy of the ear canal, as much as possible. However, by the time of surgery, the progress of the chronic ear disease has already caused a significant destruction of the middle ear, and, therefore, surgical intervention can seldom reconstruct the functional anatomy to allow undisturbed transmission of sound. Furthermore, in most cases, the surgeon has to remove important anatomical elements responsible for the sound conduction, for the sake of safety. A conductive hearing loss is the price of both the disease and the operative treatment. In addition, a sensorineural element is sometimes added to the hearing impairment, due to the effects of the chronic disease, to presbycusis, and, on occasions, to the surgery itself. If the opposite ear is normal, the patient can tolerate the unilateral hearing disability and cope without sound amplification. But in everyday practice, this is often not the case, and the use of a hearing aid is necessary.

The aim of this study was to assess the use of hearing aids by patients who had undergone a closed-cavity tympanomastoidectomy, as compared with hearing aid users with no history of ear surgery.

Materials and methods

A. Patients

The records of 223 patients, who had undergone combined-approach mastoid surgery in our unit since 1977 were retrieved, in order to find out how many of them wear a hearing aid. Thirty-nine patients were found to have a record in the Audiology Department (17 per cent), although an overall percentage of 30 per cent had hearing worse than 30 dB mean at the frequencies 500,

1,000, 2,000 and 4,000 Hz, and 60 per cent worse than 15 dB mean.

Three were excluded: The first two because they were under current surgical treatment, and the third because precise assessment was not possible, due to his being mentally handicapped. An appointment letter was sent to the rest of them, explaining the purpose of the survey in detail. Seven out of 36 failed to attend, and finally 29 patients were included in the study, 15 men and 14 women. The mean age was 50 (range 17–72, standard deviation 15).

All patients had a staged closed-cavity tympano-mastoidectomy as described previously (Robinson, 1989), and they were fitted with standard behind-the-ear hearing aids provided by the British National Health System (BE11–19, 31–35, and 51–53). Hard acrylic was used as mould material in all cases. When both ears had usable, but not normal hearing, two moulds were issued, so that the patient could use the aid in both ears, and decide in which he preferred to wear the aid. All patients were provided with a hearing aid at the surgeon's suggestion, as part of the follow-up treatment.

A questionnaire/examination form was completed by the same examiner at the interview, which included the following:

- (1) Side of operation(s) and side of hearing aid. The main focus of interest was whether or not the patient wore the aid in the operated ear.
- (2) Air-conduction thresholds in both ears, to estimate whether the aided ear was the only one suitable for a hearing aid, and whether or not the patient needed an aid.
- (3) General impression about the aid, and number of hours it was used daily.
- (4) Pre-operative use of hearing aid, and problems with it (several changes of aid or mould, or inability to use it because of discharge).

- (5) Problems with the aid after the operation(s).
- (6) Effect of the operation(s) on hearing.
- (7) Discharge pre-operatively, post-operatively, and at the time of examination.
- (8) Open mastoid cavity on the opposite side.

B. Control group

When the review of the patients was completed, the records of 56 individuals of similar age, who used a hearing aid, but had no ear surgery in their history, were selected, to serve as the control group. The selection of controls was based solely on their age, and was performed on a random basis.

An explanatory letter, a questionnaire, and a freepost reply envelope was sent to everyone of them. Seven out of 56 did not return the questionnaire (12.5 per cent), one had moved to an unknown address, and nine proved to have had ear surgery, and were therefore excluded. Finally, 39 control subjects entered the study, 21 men and 18 women. The mean age in this group was 51 (range 18–73, standard deviation 13).

The relatively high proportion of subjects who had surgery in this group (9/56, 16 per cent), was probably due to the fact that these people had their operation elsewhere, and therefore, insufficient information was recorded in the Audiology files. It must be mentioned here that none of the control subjects was under follow-up by an ENT Surgeon at the time of this study.

The information obtained from the questionnaire and the Audiology Department record, included:

- (1) Side of hearing aid.
- (2) Air-conduction thresholds in both ears, to estimate whether the aided ear was the only one suitable for a hearing aid, and whether or not the patient needed an aid.
- (3) General impression about the aid, and number of hours it was used daily.
- (4) Problems with the aid (several changes of mould or aid, or inability to use it because of discharge).
- (5) All control subjects were asked whether an appointment with an Audiology technician would be necessary.

C. Statistical analysis

The statistical analysis included:

- (1) Frequency distribution. Percentages are not used when numbers are very small (Altman *et al.*, 1989).
- (2) The variables were correlated by the Spearman's Rank Correlation Coefficient (Rs), where applicable, or by the chi square test. Confidence intervals for differences in proportions were calculated, but, due to the limited sample sizes, led to imprecise results, and are therefore not shown in the text.

The calculations were carried out on a Commodore 128 Computer, using a software package developed by one of the authors, based on generally accepted mathematical formulae.

Results

The frequency distribution for the most important variables, in the group of patients with closed mastoid cavities, wearing the hearing aid in the operated ear, are

presented in Table 1. Table II shows the results in the Control group.

Twenty-five patients were found to wear the hearing aid in the operated ear (86 per cent). More than half of them (13 patients, 52 per cent) chose this ear over the opposite one, the remaining 48 per cent being the patients who had to wear it in this ear anyway, because the other ear had either much worse or normal hearing. All three patients with an open mastoid cavity in the opposite ear, wore the aid in the ear with the closed cavity.

Twenty of the 25 patients wearing the hearing aid in the operated ear were happy with it (80 per cent). Twelve patients used it more than eight hours daily (48 per cent), two patients, four to eight hours daily, and seven patients four hours daily or less. Four patients reported no use of the aid at all. All of them had good enough hearing not to need it. On the other hand, most of the patients who needed a hearing aid were satisfied with it (Rs = 0.82, $p < 0.001$).

In the control group, 28 out of 39 subjects were satisfied with the aid (72 per cent). The difference between the two groups was not statistically significant (chi square 3.06, $p = 0.08$). Three control subjects did not wear it at all, and four wore it less than four hours daily. In this group, the percentage of patients using the aid more than eight hours daily is greater (67 per cent), but also more patients need a hearing aid (95 per cent).

Only seven patients in the Mastoidectomy group used a hearing aid before the operation(s). All of them were satisfied with the aid post-operatively.

Fifteen of the patients wearing the hearing aid in the operated ear did not have any problems with it (60 per cent). The remaining 40 per cent reported several changes of mould. No post-operative discharge was reported in this group, although the pre-operative rate of discharge was 84 per cent, and, as expected, it was positively correlated with problems with the hearing aid (Rs = 0.99, $p < 0.01$). All patients had dry ears at the time of examination.

In the control group, 59 per cent of the patients reported problems with the aid, mostly several changes of mould. The difference between the two groups, regarding these problems, was not statistically significant (chi square 2.19, $p = 0.13$).

The fact that the control group was found to have significantly higher proportion of bilateral aids (41 per cent as compared with 16 per cent in the closed cavity group) was expected, since most of these subjects suffer from presbycusis, which is usually bilateral.

About half of the controls thought that an appointment in the Audiology Department was necessary (18 patients, 47 per cent).

Discussion

Experience tells us that hearing aid fitting is not always an easy procedure. This may be due to a number of variables; the population characteristics, the age and the IQ of the patient, the type and degree of communication need, play a significant role, along with the skill and kindness of the staff involved. We chose the age as the principal criterion for the selection of the control group, because we felt that it generally reflected the need for

TABLE I
PRESENTATION OF RESULTS. PATIENTS WEARING THE HEARING AID IN THE OPERATED EAR ($n = 25$)

Variable and definition	Values	Frequency*
Side of operation	1. Left	14 (56)
	2. Right	8 (32)
	3. Both	3
Side of Hearing Aid	1. Left	12 (48)
	2. Right	9 (36)
	3. Both	4 (16)
Was the fitted ear the only suitable for a hearing aid?	1. Yes	12 (48)
	2. No	13 (52)
Need for hearing aid	1. Yes	19 (76)
	2. No	6
General impression	1. Satisfied	20 (80)
	2. Not satisfied	5
Hours (daily) the aid is used	0. No use	4
	1. < 4 hours	7
	2. 4-8 hours	2
	3. > 8 hours	12 (48)
Preoperative use of hearing aid	1. Yes	7
	2. No	18 (72)
Problems with the aid preoperatively	1. Yes	1
	2. No	6
Effect of the operation(s) on hearing	1. No change	5
	2. Better hearing	8
	3. Worse hearing	12 (48)
Problems with the aid postoperatively	1. Yes	10 (40)
	2. No	15 (60)
Discharge preoperatively	1. Yes	21 (84)
	2. No	4
Open cavity on opposite side	1. Yes	3
	2. No	22 (88)

*Number of observations (percentage)

communication, and it also played a significant role in the motivation of the subjects.

The degree of hearing loss which might be considered appropriate for the fitting of a hearing aid is a matter of debate, but a figure of 35 dB seems reasonable. Where the loss is unilateral, the good ear may need to be somewhat better than this to compensate. Haggard (1989 personal communication) has suggested that a loss of 15 dB may be significant. However, in our Unit we have been using as criterion a figure of 20 dB, and this was applied for the patients in this study.

Patients with chronic otitis are generally good candidates for a hearing aid, once the ear has been stabil-

ized, first because they are already used to dealing with ear problems, and they are, therefore, more motivated, and second because in many of the cases the deafness is mainly of a conductive type, and there is little sound distortion due to recruitment. The surgeon can help by providing a safe, dry ear, and by restoring the continuity of the sound conduction mechanism, with a tympanoplasty and/or ossiculoplasty. The preservation of the canal wall in the combined approach mastoidectomy, facilitates the procedure of the mould fitting, and ensures minimal distortion of the acoustics of the ear canal.

It has been suggested that the open cavity mastoidectomy, usually performed on a sclerotic and diseased

TABLE II
RESULTS IN THE CONTROL GROUP: HEARING AID USERS WITH NO HISTORY OF EAR OPERATIONS ($n = 39$)

Variable and definition	Values	Frequency*
Side of Hearing Aid	1. Left	7 (18)
	2. Right	16 (41)
	3. Both	16 (41)
Was the fitted ear the only suitable for a hearing aid?	1. Yes	24 (38)
	2. No	15 (62)
Need for hearing aid	1. Yes	37 (95)
	2. No	2
General impression	1. Satisfied	28 (72)
	2. Not satisfied	11 (28)
Hours (daily) the aid is used	0. No use	3
	1. < 4 hours	4 (10)
	2. 4-8 hours	6 (15)
	3. > 8 hours	26 (67)
Problems with the aid	1. Yes	23 (59)
	2. No	16 (41)
Patient wants appointment with Audiology technician	1. Yes	18 (47)
	2. No	20 (53)

*Number of observations (percentage)

mastoid, does not affect the acoustics of the canal significantly, at least compared with an open cavity in healthy, well aerated, temporal bones (Evans *et al.*, 1989). However, if the hearing level is borderline or seriously impaired, minimal alteration in the conduction of the sound wave through the external ear could be significant. In addition, most Audiology technicians would agree that the fitting of a mould in an open cavity can be difficult, especially when a wide meatoplasty has been performed. It has been known for patients to require a general anaesthetic to have impacted mould material removed from their mastoid cavities.

The hypothesis when we planned this study was that these problems do exist in a closed cavity, and, providing that the ear is dry, one would expect the fitting procedure to be at least no more difficult than in a non-operated ear. The fact that more than 86 per cent of our patients wear their aid in the operated ear, agrees with this. Furthermore, no statistically significant difference was found between the closed cavity patients wearing the aid in the operated ear, and the control group, regarding the impression about the aid, or the problems with it. Both categories were found to be doing quite well, although higher percentages have been reported (Browning, 1986).

The number of hours that the aid is worn daily is reported not as a proof of success or failure of the fitting, but as an indirect indicator. The patient's impression is the most important factor, not only in this study, but in our Clinic as well.

In the population of the 223 cholesteatoma patients reviewed, a percentage of 28 per cent were found to have bilateral disease treated surgically. Although a small percentage of these patients actually needed a hearing aid, this is another fact that shows how important an aid can be to these patients, and, therefore, how potentially beneficial could be a closed mastoid cavity to them, providing good acceptability of the instrument.

One could note that the patients who use a hearing aid but had no surgery, enjoy less attention than those who had an operation. This might be an indirect indicator of the work load of the Audiology Departments, which have usually enough staff just to cope with everyday work, and, as a rule, are unable to follow-up the thousands of hearing aid users with no recorded problems. In fact, we feel that even the 'privileged' surgical patients could have a better auditory rehabilitation, since in our series only half of the potential candidates for a hearing aid had actually been provided with one. The aim of every Otological/Audiological team is to minimize the percentage of the 'in-the-drawer-aids' as much as possible. Much work has to be done by both sides in this field, although significant progress has been achieved over the last few years.

Key words: Hearing aid; Mastoid surgery

It would be interesting to compare the closed with the open cavity mastoidectomy regarding the post-operative use of hearing aids by the patients. A study on this subject is now in progress in our Unit.

Conclusion

The destruction of the conducting apparatus by cholesteatoma and the often necessary removal of part of the ossicular chain by the surgeon, as well as the high incidence of bilateral disease, point out the need for post-operative auditory rehabilitation in these patients.

The combined approach tympanomastoidectomy offers the advantage of an intact posterior canal wall and therefore facilitates the hearing aid fitting procedure and gives a good chance of a dry ear in the presence of the aid. In this study we found similar acceptability of the instrument in patients with a closed cavity and the non-operated controls. A comparison of the closed with the open mastoid cavity regarding the use of a hearing aid is in progress.

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