

One aid or two?—more visits please!

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Abstract

A prospective trial of hearing aid provision was undertaken to define factors which might be used to allow hearing aids to be fitted optimally. Patients referred for the provision of a hearing aid were studied prospectively at each of five visits when they were questioned by means of a proforma. Fifty-six patients completed the trial and gave adequate responses for analysis. No audiometric or symptomatic criteria were found to be of use in predicting the final choice of hearing aid combination. It may be that initial sequential monaural aiding leads to a higher uptake of binaural aids in the long term. Patients valued multiple visits to the clinic and sequential trials of monaural aiding, the majority felt that binaural aids should be tried.

Key words: Hearing aid, monaural, binaural; Audiogram

Introduction

The clinician is often faced with the decision as to which aiding strategy to employ in a patient presenting with a hearing loss. Examples include always fitting the worst hearing ear, the better discriminating ear, or the right ear in right handed patients etc.

This study was performed to identify those factors which influence individual patient's choice of aiding combination. We have prospectively examined factors such as handedness, tinnitus and initial patient preference as well as measured and calculated audiometric criteria, and the sequence of aiding.

Method

We studied 64 consecutive patients referred by their General Practitioner to Ninewells Otolaryngology Department for the provision of a hearing aid. The 56 patients who completed the trial were comprised of 31 males and 25 females, mean age 67.9 years (range 40 to 83 years). Of eight patients who were excluded from the trial, one died during the trial, three refused aiding, one had a questionnaire which was too incomplete to use, one developed a discharging ear, and two did not attend for review after initial fitting of a monaural aid.

Entry criteria were as follows:

- (1) no previous hearing aid provision;
- (2) no evidence of active otitis externa or media;
- (3) no mental or physical disorder which would interfere with the use of a hearing aid;
- (4) mean pure tone thresholds (at 0.25, 0.5, 1, 2, 4 and 8 kHz) worse than 25 dB HL;
- (5) no primary complaint of tinnitus.

A history was taken to establish the aetiology of hearing

loss and the presence and side of any tinnitus. The patient's handedness and preferred aiding strategy was noted. Both ears were examined.

Pure tone and audiometry was performed at the frequencies 0.25, 0.5, 1, 2, 4 and 8 kHz for air conduction and 0.25, 0.5, 1, 2 and 4 kHz for bone conduction using a standard method (British Society of Audiology, 1981). This was carried out in a sound-proof room using a Madsen OB822 audiometer. Masking was used where necessary. The uncomfortable listening level was measured using a standard method (British Society of Audiology, 1987). Speech audiometry was performed using a Kamplex AC4 audiometer and Arthur Boothroyd 10 word speech lists.

Uncomfortable loudness levels (ULL) were measured for each patient over the frequencies 0.5 to 4 kHz, and differences between the air conduction thresholds and ULLs were calculated. Mean sensitivity differences and audiogram shape differences between ears were calculated (Cheung and Stephens, 1986), and considered significant if greater than 10 dB.

Impressions were taken from both ears at the first visit. At the second visit four weeks later, the patients were randomized into one of two groups. One group ($n = 37$) was fitted with monaural aids (18 left, 19 right) and the remainder ($n = 19$) with binaural aids. The standard range of NHS hearing aids were used in all but two patients who received a Pico Forte and Widex G2H hearing aid. All aids were chosen to best match the hearing loss in each ear. Thirteen aids were exchanged for a more powerful type at subsequent visits during the trial, and in one case the aid was exchanged for a less powerful one.

At the third visit patients with binaural aids were randomly deprived of one aid, and those previously aided monaurally had the aid exchanged for one in the opposite

TABLE I
FINAL AID PREFERENCE VERSUS SIDE OF TINNITUS

	Right (n = 10)	Left (n = 8)	Bilateral (n = 7)
Chosen aid side:			
Right	4 (40%)	3 (38%)	1 (14%)
Left	4 (40%)	2 (25%)	2 (29%)
Bilateral	2 (20%)	3 (38%)	4 (57%)

ear. At the fourth visit, the monaurally aided group were given binaural aids. The original binaurally aided group had their monaural aid exchanged for another in the opposite ear.

Each aiding combination was given for 10 weeks. Assessment was made by questionnaire at each visit (see Appendix A). At the first visit each patient was given their preferred aiding arrangement.

Results

No association was found between age or sex and preference for monaural or binaural hearing aids. The average age of patients with a preference for binaural aids was 68.5 years (40–83 years) and for monaural aids 69.5 years (44–83 years). Eleven (44 per cent) women and 11 (36 per cent) men preferred binaural aids.

Fifty-three patients were right handed and three were left handed. Eighteen (34 per cent) right-handed patients preferred left-sided aids and 14 (26 per cent) right-sided aids; the remaining patients chose binaural aiding. Each of the three left-handed patients preferred a different arrangement.

Tinnitus was reported by 25 (45 per cent) patients, being unilateral in 18 (72 per cent) and bilateral in 7 (28 per cent). No correlation was found between eventual aiding and localization of the tinnitus (Table I).

Mean pure tone thresholds did not influence the choice of aiding arrangement, but there was remarkable similarity between these means, all were within 2 dB of 52 dB HL. The average difference between pure tone thresholds and ULLs was 53 dB in monaural users and 55 dB in binaural users.

Optimum discrimination scores differed significantly (range 10 to 40 per cent) in 22 (39 per cent) patients. Of these, only seven (32 per cent) chose a monaural aid in the better ear (ODS range 48 to 98 per cent); six (27 per cent) chose a monaural aid in the worst ear (ODS range 64 to 90 per cent). Binaural aids were chosen by nine (41 per cent) (ODS range 80 to 100 per cent in the better ear, 40 to 90 per cent in worst ear).

Significant sensitivity differences alone (mean 17.4 dB, range 10 to 33 dB) were present in eight (14 per cent) patients. Of these, five chose binaural and three monaural hearing aids. Significant audiogram shape differences alone (mean 12.3 dB, range 10 to 16 dB) were

found in three (5 per cent) patients. Of these, two chose binaural and one monaural hearing aids. Significant differences in both sensitivity (mean 25.8 dB, range 19 to 41 dB) and shape (mean 14 dB, range 10 to 24 dB) were found in six (11 per cent) patients. Of these, two chose binaural and four monaural hearing aids.

No patients initially chose binaural aiding despite the open offer. Only 14 (37 per cent) of those initially choosing monaural aiding kept their original preference for side. Of the 18 (32 per cent) gave no initial preference, 11 (61 per cent) eventually chose monaural aiding and seven (39 per cent) chose binaural aids. Twenty-four (63 per cent) changed to a different combination, nine (24 per cent) to the opposite ear and 15 (39 per cent) to binaural aids.

Only three (16 per cent) of the 19 patients initially given binaural aids eventually chose this arrangement. Nineteen (53 per cent) of the 36 patients given binaural aids at the fourth visit chose binaural aids. Nineteen patients were aided monaurally at the fourth visit. Of these, ten (53 per cent) chose the last aiding combination, six (32 per cent) chose the opposite ear and three (16 per cent) chose binaural aiding. When asked at the last visit to choose a side with monaural aiding as the only option, no significant association was found between the last monaural aiding combination tried and that chosen by the patient ($p > 0.05$) (Table II).

Binaural aids were eventually chosen by 22 (39 per cent) patients. If only allowed monaural aiding, 14 (64 per cent) preferred a monaural aid in the initially aided ear (two were undecided). In those finally choosing a monaural aid, only ten (29 per cent) chose the initially aided ear.

Combined figures from all visits showed the surprising result that sound localization was better when monaurally aided, and 18 per cent found localization worse when binaurally aided than when unaided (14 non-responses; 8 per cent). Speech discrimination in noise was best in the monaurally aided, where 65 per cent reported improvement and 43 per cent of all patients felt binaural aids made speech discrimination in noise worse than when unaided (seven non-responses; 4 per cent).

The frequency of monaural hearing aid use (by ear) was reported as follows: 76 (70 per cent) used them at least six days per week, six (6 per cent) for less than two days per week (three non-responses; 3 per cent). Ninety-three (84 per cent) responses from patients when issued with one hearing aid (one non-response; 1 per cent) and 28 (54 per cent) patients when issued with binaural aids described their usage as either often or all the time (four non-responses; 7 per cent). Of patients preferring binaural aiding, 22 per cent wore the aids prescribed at all fittings for longer than 12 hours per day, whereas only 7 per cent of patients preferring a monaural aid wore the aids prescribed at each fitting for as long.

Patients satisfaction with their aiding combination at

TABLE II
SIDE OF LAST MONAURALLY FITTED AID VERSUS preference.
(question asked after last monaural fitting)

Last monaural fitting (imposed)	Right (n = 27)	Left (n = 26)	Either (n = 3)
Right	15 (56%)	13 (50%)	1 (33%)
Left	12 (44%)	13 (50%)	2 (67%)

TABLE III
SATISFACTION AT EACH VISIT WITH PRESENT AIDING ARRANGEMENT

Satisfaction [responses (% responses)]	Monaural (n = 112)	Binaural (n = 56)
Good/excellent	96 (86%)	39 (70%)
Dissatisfied	15 (13%)	15 (27%)
Non-responses	1 (1%)	2 (3%)

each visit is summarized in Table III. Reasons for dissatisfaction were given in 22 cases. The most common complaint being background noise (six patients with binaural and one with monaural aiding), and poor speech discrimination (four patients with monaural and three with binaural aiding). The remaining complaints included discomfort, distortion, excessive volume, insufficient volume and feedback.

After making their final choice of hearing aid, patients were asked which aiding strategy they thought should be offered routinely: 31 (55 per cent) preferred initial monaural aiding followed by the routine provision of a second aid; 15 (27 per cent) patients preferred initial binaural aiding; nine (16 per cent) felt a second aid should only be provided on request.

Discussion

Age did not affect the uptake of binaural aids and in fact the oldest patient in the trial (83 years) chose binaural aids. This agrees with a study by Stephens *et al.* (1991), but disagrees with Swan (1989) who found a significantly lower acceptance of binaural aids over the age of 75 years. The finding that equal numbers of each sex chose binaural aiding is in agreement with Brooks and Bulmer (1981), but opposes Cheung and Stephens (1986), who showed that males were more likely than females to accept binaural aiding. Only one patient in our study mentioned cosmesis as a factor for not choosing binaural aiding. The general assumption that handedness should determine the side of a hearing aid appears unfounded.

The absence of correlation between the side of tinnitus and eventual aiding preference may be explained by the entry criteria forbidding tinnitus as a main presenting complaint. Brooks and Bulmer (1981) found binaural hearing aids significantly better than monaural aids in reducing problems associated with tinnitus.

The severity of hearing loss as gauged by pure tone audiometry did not influence the side of aiding or choice of binaural aiding. It is interesting to note how constant the average pure tone thresholds were (i.e. range 50 to 54 dB HL). It may be that this is the lowest tolerable mean level of hearing, below which patients seek help. These findings contradict those of Stephens *et al.* (1991), who propose that hearing aid choice is largely for acoustical reasons, but agree that choice was not influenced by the sequence in which aiding combinations were tried. Differences between ULL and pure tone air conduction thresholds (used to indicate recruitment) did not influence hearing aid preference.

Forty-two (75 per cent) patients changed from their initial choice, suggesting that this is of little value in determining the optimal aiding strategy. Eighteen (32 per cent) patients showed no initial preference for any particular aiding strategy, and none suggested initial binaural aiding. Hearing-impaired patients appear to accept monaural aiding as the norm. Despite this, 22 (39 per cent) eventually chose binaural aiding.

Provision of binaural aids following a trial of sequential monaural aiding in each ear led to a 53 per cent uptake of binaural aiding, as compared with a 16 per cent uptake where binaural aiding was tried initially. This suggests that a period of adjustment to the use of hearing aids is required, and that such adjustment is easier when one ear is aided at a time.

The high utilization rate (for all aiding combinations) found in this study may demonstrate the greater benefit obtained from hearing aids when frequent visits are made to hearing aid clinics, as found by Aasen (1970).

Patients made an active choice of monaural aiding as after monaural aiding in each ear the preference given was frequently different from the last aid used ($p = 0.05$). Interestingly, when given monaural aiding as the only option, 14 (64 per cent) eventual binaural users chose the initially aided ear, compared with ten (29 per cent) eventual monaural users. This may be explained if those choosing monaural aiding find a single aid satisfactory in either ear, and accept the last monaural aiding arrangement. Those choosing binaural aiding may find neither ear satisfactory when monaurally aided, and therefore tend to choose the ear opposite to the one aided (unsatisfactorily) at the last visit.

Poorer sound localization with binaural aiding was a surprise result. Theory suggests that normal sound localization is dependent on inter-aural differences in time, phase and intensity. These elements can only be appreciated together if the hearing in each ear is matched with that of its fellow (Kodman, 1961). The results of this study may be influenced by reduced benefit in the initially binaurally aided group. Cheung and Stephens (1986) found a significant improvement in localization score in frequent users as compared with infrequent users.

Speech discrimination in noise was found to be better in 70 (65 per cent) responses using monaural aids, and worse in 21 (40 per cent) patients while using binaural aids. These findings agree with those of Schreurers and Olsen (1985), who showed that patients using aids in every day listening situations found monaural aids were better in noise. The theoretical 2 to 3 dB squelch advantage and 6 to 7 dB gain from eliminating the head shadow effect do not seem helpful in practical situations (Bergman, 1957).

More patients who chose binaural aiding used all hearing aid combinations for more than eight hours per day when compared with eventual monaural users. This difference was even more pronounced in those using aids for greater than 12 hours per day. This suggests that those choosing binaural aids either have a greater need for or derive greater benefit from hearing aids than those choosing monaural aiding.

This study agrees with Swan *et al.* (1986), who found that when fitting monaural aids, the patient's final preference could not be reliably predicted using audiometric data, and suggested the routine issue of bilateral ear moulds, but only one hearing aid.

Despite the inconvenience of multiple visits, sequential monaural aiding was favoured. These visits were also beneficial as 14 patients needed to change the strength of hearing aid. Most patients valued the offer of a trial of binaural aiding, with more than 90 per cent feeling the routine offer of a second aid worthwhile.

We believe that in the absence of a clear audiometric guide, patients should be monaurally aided initially. Subsequently a second hearing aid should be issued for the opposite ear and the patient reviewed to establish their preference, and the suitability of the type of aids issued. This strategy may lead to more patients being issued with binaural hearing aids. This will necessitate increases in both the availability of audiometricians and funds for the extra hearing aids.

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Appendix A

Hearing aid questionnaire

Monaural 1

With regard to the hearing aid you have been issued with over the last ten weeks, please ring the correct answer to the following questions and fill in further details where necessary.

- Has the hearing aid been
 - Very satisfactory
 - Satisfactory
 - Unsatisfactory
 - Very unsatisfactory
 If unsatisfactory, in what way?
- Did you use the hearing aid
 - All the time
 - Most of the time
 - Often
 - Only on special occasions
 - Never
- On average how many days a week did you use the aid?

a) 0	c) 2	e) 4	g) 6
b) 1	d) 3	f) 5	h) 7
- On average how many hours a day did you use the hearing aid?

a) 0	b) Less than 1	c) 1 to 4	d) 4 to 8
e) 8 to 12	f) More than 12		
- When you are listening to speech in noisy situations has this hearing aid
 - improved your ability to hear speech

- made no difference
- made it more difficult to hear speech

- When you hear a sound, e.g. a car horn, has this aid
 - helped you to tell from which direction the sound is coming
 - made no difference
 - made it more difficult to tell from which direction the sound is coming
- Do your ears make noises, e.g. buzzing or hissing? YES/NO
If yes, please specify the sort of noise.....

Has this hearing aid

- reduced your awareness of the noises
- made no difference
- made your noises worse

Monaural 2

This was identical to the above questionnaire, but included the additional question below:

Now that you have tried a hearing aid separately in each ear, if you could only have one hearing aid, which ear would you prefer to wear it in?

Left/Right/Neither

Binaural

This was identical to the questionnaire 'Monaural 1', except for the omission of the question, 'On how many days per week was the aid used?'

Two questions were asked of all patients on completion of the trial:

- Now that you have tried the use of one hearing aid in each ear and hearing aids in both ears together, which do you prefer?

Two hearing aids or one hearing aid

If one hearing aid: which ear would you prefer it in?

Right/Left

Why?
- As a result of your experience in trying these hearing aids, what do you think is the best way for us to go about fitting someone with hearing aids?
 - To give them two hearing aids to begin with and tell them to give one back if they prefer to use one rather than two.
 - To give them one hearing aid to start with and routinely give them a second to try at a later date.
 - To give them one hearing aid to start with and only give them a second one at a later date if they ask for it.

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