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Effect of Earmold Venting on Insertion Gain

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Abstract

Earmold modifications are recommended to vary the electroacouslic output of hearing aids to suit the individual requirements of the hearing -impaired. Parallel and diagonal venting of earmolds are utilized to boost and I or reduce the gain of the hearing aid at specific frequencies. This study reports the effect of earmold venting in hearing aid users. Insertion gain measurements were carried out using Madsens IGO 1000. The effect of earmold venting on the gain of the hearing aid at different frequencies were analysed. The study indicated that there was no significant difference between vented and non-vented ear molds.

Introduction

Earmold modifications are recommended for varying the electroacoustic output of hearing aids to suit the individual requirements of the hearing impaired. Venting of earmold is one of the ways by which the electroacoustic output of the hearing aid can be modified.

The traditional approach towards fitting individuals with sloping high frequency losses, has been to manipulate the tone control setting of the hearing aid. However by manipulation of the tone control alone it is not possible to get the optimally required electroacoustic output from a hearing aid.

It has been reported in literature (Lybargcr 1985) that vents of specific dimension can cither reduce the low frequency or boost low frequency.

Until recently two methods have been used to study the effect of venting. One being the measurement of electroacouslic characteristics using HA - I couplers, and the other by obtaining functional gain by establishing behavioural responses in a freefield set-up.

Insertion gain measurement have brought to light another procedure for measuring the effects of earmold modifications.

The advantage of insertion gain measurements is that it permits :
(a) evaluation in the ear instead of in a coupler, and (b) provides information in 1 dB steps across all frequencies rather than in 5 dB steps at discrete frequencies as is usually measured in functional gain measurements. Insertion gain measurements also allows easy comparison of the elcctroacoustic output of the hearing aids with the prescribed gain curve.

This study investigated the effect of parallel venting of earmolds, using insertion gain measurements.

Methodology

Subjects

Four adults served as subjects for whom both ears were studied. All subjects had bilateral sloping sensori neural hearing losses. The subjects were tested while wearing custom made acrylic hard earmolds.

Instrumentation

The Madsen IGO - HAT 1000 was utilized to obtain insertion gain measurements.

Procedure

Stage - 1 : Functional Gain Measurements.

To begin with the subjects were tested using nonvented custom earmolds. Testing was carried out in the language most familiar to them. The test stimuli included (a) everyday questions, and (b) spondees / paired words. The functional gain testing was done in a quiet room.

Since the performance of the subjeets with nonvcnted earmolds was not satisfactory, venting was recommended. All the subjects were adviced parallel venting. Parallel venting was preferred over side - branch venting due to its advantages that have been quoted in literature. Johansen (1975, cited in Leavitt, 1981) and Studebaker & Cox (1977) have reported that side - branch venting results in undesirable loss of high frequency energy, and the increased likelihood of acoustic feedback resulting from the greater loss of high frequency energy out from the side - branch vent.

Stage - II: Functional gain testing was once again repeated with patients wearing their parallel vented earmolds. The hearing aid with which the patient performed best during functional gain testing was used for insertion gain measurements. Insertion gain measurements were obtained using Madsen IGO - HAT 1000. POGO 2 (Schwartz et. al., 1988) was the prescriptive procedure used to predict the most appropriate gain - frequency response curve from the hearing aid.

The following procedure was used to obtain measurements. The subject was scaled one meter in front o f the loudspeaker. Unoccludcd carcanal resonances were obtained initially. Following this, insertion gain curves with parallel vented custom earmolds coupled to the preselected hearing aid, was got. Sweep frequency warble tones (250 Hz to 8 KHz) presented at 60 dBSPL were the stimuli used. The insertion gain curves were obtained with the hearing aid set in different tone and volume control settings in order to approximate the prescribed target curve. The target curve that deviated the least from the target curve was chosen for analysis.

In order to obtain the effect of venting, nonvented insertion gain measurements were carried out. The settings of the hearing aid was same as when evaluating with the vented earmolds. The nonvented measurements were obtained by blocking the vent with thermocol at the canal end of the earmold.

The significance of difference at the 0.01 level and 0.05 level were determined. Table - I indicates the significance at the 0.01 level and the 0.05 level.

The analysis revealed that the insertion gain curves for both vented and non vented earmolds, when compared to the POGO2 curve, were significantly different at the 0.05 level for 1500 Hz and at the 0.01 level for frequencies 2000 Hz and 3000 Hz. Both the vented and nonvented curves were not significantly different from the POGO2 curve from 250 Hz to 1000 Hz.

Table - I : Significance of difference between (a) POGO2 curve and nonvented gain curve, (b) POGO2 curve and vented gain curve, and (c) nonvented and vented gain curves, at the 0.05 and 0.01 levels (Siegcl 1956).

	Levels of significance	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 **Hz**	3000 Hz
POGO2 curve minus	0.05	NS	NS	NS	NS	S	S	S
rionvented gain curve	0.01	NS	NS	NS	NS	NS	S	S
POGO2 curve minus	0.05	NS	NS	NS	NS	S	S	S
vented gain gain curve	0.01	NS	NS	NS	NS	NS	S	**s**
Vented minus	0.05	NS	NS	NS	NS	NS	NS	NS
nonvenled gain curves	0.01	NS	NS	NS	NS	NS	NS	NS

Results and Discussion

The Walsh Test (Siegel 1956) was utilized to analyse the significance of difference between the following insertion gain curves :

a) POGO 2 curve Vs nonventcd curve
b) POGO 2 curve Vs vented curve, and
c) Non vented curve Vs vented curve.

The significant difference at the higher frequencies between between the P0G02 curve and the insertion gain curves can be explained by the fact that hearing aids used in this study did not provide adequate amplification in the high frequencies.

Table - II : Average of nonvented, vented and PCX •O2 curves aero s frequencies.

	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz
Nonventcd gain curve	0.5	10.63	18.38	22.75	23.06	20.25	8.31
Vented gain curve	0.5	9.5	1 7 00	21.57	28.88	23.38	11.25
POGO2 curve	1.25	13.38	15.63	20.88	25.38	30.63	40.13
Vented minus nonvented curves	OOfl	-1.13	-1 *Mi*	-1.00	5.82	3.13	2.94

The average scores of the vcnlcd and nonvented curves (Table - II) show that for the frequencies below 1000 Hz, the nonvented insertion gain curve had a slightl y higher gain than the vented curve. However the difference was not greater than 1.38 dB. Lybarger (1978) has reported that parallel vents usually reduce the gain in the low frequencies. The amount of reduction is dependent on the length and diameter of the vent. Maximum reduction is seen in molds having vents that are short in length and large in diameter. He noted that vents having a length of 6.3 mm and diameter of 3 mm resulted in a reduction of as much as 29 dB at 200 Hz, 24 dB at 250 Hz, 20 dB ai 315 Hz, 16 dB at 400 Hz, HdBat500Hz, and 5 dB at 630 Hz. However vents having relatively longer length and small diameter produce no low frequency attenuation and may even result in low frequency enhancement (i.e. for vents with lengths of 22 mm and diameter of 1 mm).

It has been the experience of the authors that most Indians have narrow ear canals, making it difficult to provide parallel vents in the cannolds. In the rare individual whose earcanal diameter permits provision of a parallel vent, it is often not possible to make the vent diameter large enough lo provide adequate reduction of gain in the low frequencies. This can account for the reduction of not greater than 1.38 dB in the low frequencies.

In the higher frequencies, i.e. from 1500 Hz to 3000 Hz the vented curve was greater that the nonvented curve (Table -II). The average increase in amplification was 5.82 dB at 1500 Hz, 3.13 dB at 2000 Hz and 2.94 dB at 3000 Hz. Thus, though there was no significant difference bel ween the vented and nonvented insertion gain curves as per the Walsh test, venting did result in a marginal increase in high frequency amplification. Lybarger (1978) has also documented minimal increases of 1 to 4 dB in the frequency range of 1000 Hz lo 1600 Hz.

Thus it can be concluded that, had it been possible to provide wider vents, there might have been a greater difference between the vented and nonvented insertion gain responses.

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References

Leavitt, R., "Earmolds : Acoustic and structural considerations". In W.R. Hodgson and P.H. Skinner, (Ed.), *Hearing Aid Assessment and Use in Audiologic Habilitaiion.* Ed.2, Baltimore, Williams and Wilkins, 73 - 114, 1981.

Lybarger, S., "Earmolds" In J. K atz, (Ed.), *Handbook of Clinical Audiology,* Ed.3, Baltimore : Williams and Wilkins, 885-910, 1985.

Lybarger, S. "Earmolds"In J. Katz, (Ed.), *Handbook of Clinical Audiology,* Ed.2, Baltimore : Williams and Wilkins, 508 - 542, 1978.

Siegel, S., "Nonparametric statistics - For the beahvioural Sciences", 88 - 87, McGraw-Hill, 1956.

Studebaker, G., and Cox, R. (1977). "Side - branch and parallel vent Effects in Real Ears and in Acoustical and Electrical models" *Journal of American Audiological Society,* 3, 108 - 116.

Schwartz, D.M., Lyregaard, P.E., and Lundh, P. (1988) "Hearing aid Selection for severe to profound Hearing Loss" *The Hearing Journal.* 41, 13 -17.