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Original Article

Effect of vents on the output of hearing Aids

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Abstract:

The aim of the study was to explore the effect of vents on the speech discrimination scores and electroacoustic characteristics of body level hearing aids. The Nineteen adults who participated in the study had mild to moderate sloping sensori-neural hearing loss and were in the age range of 18-70 years. Apart from 19 hearing aids users additional 11 hearing aids were also taken for the study of electro-acoustic characteristics only. Major changes in the electro-acoustic characteristics of the body worn hearing aids was observed on HFA OSPL90, FOG and EINL which reduced to 7.31%, 9.19% and 7.72% when parallel vent of 2mm were bored in the regular ear moulds respectively. Parallel/ Diagonal vents improved the Speech Discrimination score by 9%. The cumulative impact of venting can be seen on improvement of speech discrimination scores and subjective impression of clear speech.

Key words: *Ear moulds, parallel venting, diagonal venting, electroacoustic characteristics, analog hearing aids, sloping sensori-neural hearing loss.*

Introduction:

This study was conducted to find the difference in electro-acoustic characteristics of the body worn hearing aids when fitted with regular, parallel or diagonally vented ear mould and its affect of the word discrimination scores on subjects having sloping sensori-neural hearing loss.

Hearing scientists are in constant search for technology which can provide clarity of sound and ease of listening to the persons with hearing impairment. There is approximately 1.262 to 1.849 million people with hearing disability in India and the numbers are likely to be more, if people with hearing impairment of mild to moderate degree in one or both ears are also included (NSSO 2002 and Census of India, 2001). The function of hearing aid is to amplify sounds for the maximum benefit for the persons with hearing impairment. Scientist Alexander Graham Bell work on telephone led to the development of body level hearing aid and first commercial body level hearing aids were available in 1930[1,2].

Hearing aid is basically a public address system [3]. With invention of transistor, the hearing aid miniaturization took place and behind the ear (BTE) hearing aid was commercially available in 1950's. Technology of printed circuit, miniaturization of the amplifiers, microphones and battery led to the development of the in-the-ear (ITE), canal and completely-in-the canal (CIC) hearing aid.

The ear mould is a vital component of any hearing aid since it forms the connection between the ear and hearing aid. Ear moulds are the most important factor in the inhibition of acoustic feedback (the whistle sound heard when sound escapes from any part of the hearing aid and then re-enters the hearing

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aid microphone to be amplified again). Feed back is not only annoying; it also reduces the amount of useful amplification that the person receives and impacts on the person's listening skills. One of the most important steps in fabrication of the ear mould is to make accurate ear impression. The accuracy of the impression will determine the comfort, seal and fit of the ear mould or hearing aid – all factors that will play a major role in the success of fitting of the hearing aid.

Vents are usually fitted to low and moderate gain hearing aids only, since the presence of a connection through the ear mould can encourage acoustic feedback. Vented ear moulds affect the amplification and transmission of low frequency sounds that enter the ear canal via the hearing aid. By providing a free passage of air, unwanted low frequency sounds can escape through the vent, effectively reducing the amount of low frequency amplification that the person with hearing impairment is receiving. Venting mainly affect the low frequency response from 0 Hz up to approximately 1 KHz, with the frequency range affected depending strongly on the vent size and hearing aid gain[4]. In terms of comfort and aeration, the wider the vent, the greater the benefits[5]. Wide, short vents give the greatest reduction in low frequency amplification. Vents have the advantage of being able to be used with all types of hearing aids and can often be inserted or modified by the audiologist very quickly and easily. Venting is one of the simplest means of reducing the occlusion effect (OE) and reducing excessive low frequency amplification. Vents may not be fitted if there is risk of acoustic feedback, the ear canal is too small to allow room for the vent or low frequency amplification is needed.

Audiologists choose the size of the vent based on the requirement of each person. Venting has significant effects on output of the hearing aids thus significantly vary the word discrimination scores. Brugel and colleagues demonstrated the improvement in the word discrimination scores with different dimensions of the vents[1]. Choice of venting for a particular individual is perhaps the most subjective of all decisions made by clinicians in hearing aid fittings. This study made an attempt to find the change in the electroacoustic characteristics of hearing aids with vent of different types in case with sloping sensori-neural hearing loss using body worn hearing aid. The effect of vent on regular ear mould and improvement in word discrimination scores measure serves as an index of improvement in comfort of listening.

Aim of the study:

To examine the change in the electro-acoustic characteristics for parallel vent and diagonal vent in body worn hearing aid users and to estimate the effect of parallel and diagonal vent on speech discrimination score in body worn hearing aid users.

Objective of the study is to measure the electroacoustic characteristics of mild and moderate categories of body worn hearing aids, a regular earmould in the body worn hearing aids, parallel venting of a regular ear mould in the body worn hearing aids, also to measure and compare the effect of venting on word discrimination scores.

Method:

Participants: subjects with acquired (post lingual) sloping hearing loss were selected for the study. All subjects had verbal mode of communication. 19 (14 male and 5 female) adults in the age range 18-70 years participated in the study. All the subjects were using monaural body worn hearing aids with regular ear moulds. Apart from 19 individual hearing aids of the participants additional 11 hearing aids were also taken for the study of electro-acoustic characteristic only.

Tools: MAICO MA 53 Diagnostic audiometer with free field system and GSI-38 Immittance meter were used in the study for hearing assessment and word discrimination scoring of all the participants. Fonix FP 40 D hearing aid test system was used for electro-acoustic characteristics measurement of the body worn hearing aids in sound treated room. All the tests were carried out in Audiometric Test Room as per ANSI S3.1-1991 specification. Test material for measurement of word discrimination score developed by Mayadevi 1978 (ISHA PB WORD LIST-4) was used.

Procedure: Cases having sloping hearing loss with maximum hearing loss of 40dBHL at 250Hz and 500Hz were selected. Custom made ear mould were fabricated for all the subjects later a 2mm parallel vent and then diagonal vent of the same diameter was made by blocking the parallel vent with cold cure material. All the 19 subjects took word discrimination score task with headphone and in free field conditions. In free field condition subject wore body worn hearing aids with tone control set to N position with regular mould, parallel vented and diagonally vented ear moulds.

Five Electro-acoustic characteristic [High Frequency Average Output Sound Pressure Level with input of 90dB (HFA OSPL90), Full on Gain (FOG), Equivalent Input Noise Level (EINL), Total Harmonic Distortion (THD) and frequency Limit (F1-F2)] were measured for all the 30 hearing aids with regular ear mould, parallel and diagonal vent. Syllable discrimination scores for the 19 subjects fitted with regular, parallel and diagonally vented ear moulds were also measured. One way ANOVA, Friedman's test and paired t test for pair wise comparison was implemented for statistical analysis of the data.

Results and discussions:

Word discrimination scores with body worn hearing aid are better in parallel and diagonally vented ear moulds when compared to regular ear mould and headphone condition. OSPL 90, FOG and EINL are highest in regular ear mould than parallel and diagonally vented ear mould with body worn hearing aids. There is no significant difference in between parallel and diagonally vented ear moulds. THD at 500Hz is highest in parallel vented earmould than diagonally vented ear moulds and regular ear moulds. There is no significant difference in between regular and diagonally vented ear moulds. THD at 1000Hz is highest in regular and parallel vented earmould than diagonally vented ear moulds. There is no significant difference in between regular and parallel vented ear moulds. THD at 1600Hz is highest in diagonally and regular vented ear mould than parallel ear moulds. There is no significant difference in between regular and diagonally vented ear moulds. There is no significant difference in F1 and F2 values in body worn hearing aids between regular, parallel and diagonally vented ear moulds.

Major changes in the electro-acoustic characteristics of the body worn hearing aids was observed on HFA OSPL90, FOG and EINL which reduced to 7.31%, 9.19% and 7.72% when parallel vent of 2mm were bored in the regular ear moulds respectively. Not many changes were observed in total harmonic distortion and frequency limits. Present study did not find significant changes in the electro-acoustics characteristics between the parallel and diagonal venting of 2mm made in the regular ear moulds. Parallel/ Diagonal vents improved the Word Discrimination score by 9%. All the participants reported ease of listening along with a better discrimination. The cumulative impact of venting can be seen on improvement of word discrimination scores.

Conclusion:

Thus it can be concluded that word discrimination scores in hearing impaired individuals with sloping hearing loss with approximately 40 dBHL hearing loss at the low frequencies using body worn hearing aids are better in parallel and diagonally vented ear moulds when compared to regular earmould and headphone condition. OSPL 90, FOG and EINL are highest in regular ear mould than parallel and diagonally vented ear mould with body worn hearing aids. There is no significant difference in between parallel and diagonally vented ear moulds. THD at 500Hz is highest in parallel vented earmould than diagonally vented ear moulds and regular ear moulds. There is no significant difference in between regular and diagonally vented ear moulds. THD at 1000Hz is highest in regular and parallel vented earmould than diagonally vented ear moulds. There is no significant difference in between regular and parallel vented ear moulds. THD at 1600Hz is highest in diagonally and regular vented ear mould than parallel ear moulds. There is no significant difference in between regular and diagonally vented ear moulds. There is no significant difference in F1 and F2 values in body worn hearing aids between regular, parallel and diagonally vented ear moulds. In clinical practice especially with the analog body worn hearing aids, audiologist must conduct the hearing aid trial with regular mold as well as vented moulds. The better discrimination scores and the perceptive good quality of amplified sound must guide the choice of ear mould and the tone control setting for the benefit of persons with sloping configuration of their hearing loss.

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