Unilateral Hearing Loss: the Benefit of Auditory Localization after Adaptation of Hearing Aids Individual

Perda Auditiva Unilateral: Benefício da Localização Auditiva após Adaptação de Aparelho de Amplificação Sonora Individual

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SUMMARY

Introduction: A unilateral hearing loss is characterized by decreased hearing in one ear.
Objective: To evaluate the benefit on the location after hearing the adaptation of hearing aids Individual (HA) in individuals with unilateral hearing loss.
Method: A prospective study of 31 individuals aged between 18 and 75 years and both genders with unilateral hearing loss of various types and grades, answered a questionnaire to evaluate the location of the sound source, by using the "Survey of hearing ability of the location of the sound source." The instrument was applied in two situations: without the use of HA and the use of hearing aids.
Results: Patients with mild hearing loss and received a moderate score of 3.35 with use of hearing aids and hearing loss, severe and profound absence of an improvement of 3.05 1.39 and 1.38 respectively.
Conclusion: Benefits were obtained with the use of hearing aids on the auditory localization in subjects with unilateral hearing loss, emphasizing the importance of the use of amplification.
Keywords: hearing loss, unilateral; hearing aids; questionnaires.

RESUMO

Introdução: A perda auditiva unilateral é caracterizada pela diminuição da audição em apenas uma orelha.
Objetivo: Analisar o benefício quanto à localização auditiva após a adaptação do Aparelho de Amplificação Sonora Individual (AASI) em indivíduos com perda auditiva unilateral.
Método: Estudo prospectivo com 31 indivíduos com idade entre 18 e 75 anos e de ambos os gêneros com deficiência auditiva unilateral de tipos e graus variados, responderam a um questionário para avaliação da localização da fonte sonora, sendo utilizado o "Questionário de habilidade auditiva da localização da fonte sonora". O instrumento foi aplicado em duas situações: sem o uso do AASI e com o uso do AASI.
Resultados: Os pacientes com perda auditiva de grau leve e moderado obtiveram um escore de 3,35 com uso do AASI e perda auditiva severa e profunda 3,05 havendo uma melhora de 1,39 e 1,38 respectivamente.
Conclusão: Ocorreu benefício com o uso do AASI quanto à localização auditiva em indivíduos com perda auditiva unilateral, evidenciando a importância do uso da amplificação.
Palavras-chave: perda auditiva unilateral, auxiliares de audição, questionários.

Introduction

A unilateral hearing loss may be responsible for academic difficulties, speech or language difficulties and social-emotional (1), is characterized by decreased hearing in one ear and occurs predominantly in males (2).

One study (3) was identified as major causes mumps, ototoxicity, meningitis, PAIR, chickenpox, head trauma and unilateral hearing loss of unclear cause. The aplasia of the cochlear nerve was considered the main cause of unilateral hearing loss in a retrospective study of 480 children at a hospital in Philadelphia (4). Recent data demonstrate the occurrence of a unilateral hearing loss for every 1000 live births (5).

The effects of unilateral hearing loss are smaller than those caused by bilateral loss, however, in the presence of environmental noise individuals are more difficult than the normal listeners to understand speech, even when the ear is better positioned toward the talks. Furthermore, the spatial location of sound sources is compromised (6).

The location is affected because individuals with unilateral hearing loss do not have the benefit of interaural time: when a sound comes from one direction, the time difference and interaural phase differences of continuous sounds in both ears allows the individual to determine which direction the sound is coming. The location favors the individual's sense of security within your environment for mobility and communication; there may be situations where the individual takes to locate the speaker, thereby losing the message (7).

Humans are able to distinguish one sound source that has only two degrees of difference from the horizontal plane and if it is located in front. The ability to determine the direction of the sound source is based on the fact that sounds reach both ears at the time, phase, intensity and / or different frequency. For continuous sounds, the biggest clue to the location of the signal horizontal (right - left), frequencies below 1500 Hz is the interaural time difference, presented in both ears, while the biggest clue to the high frequencies is the difference interaural intensity and spectral cues (8).

The hearing abilities for the perception and organization of the auditory environment depend in part on the use of both ears and the result of interactions that occur between neural signals and progress through binaural auditory pathway (9).

A person with unilateral hearing loss has difficulty understanding speech in noise due to reduced binaural benefit: normal hearing in both ears helps the detection and organization of speech in noise (10,11).

Individuals with difficulty in locating the sound source have lower speech recognition in noise environments with competition increasing in them the sense of confusion and loss of concentration (12).

The problems caused by sensory deprivation can be minimized with the use of hearing aids Individual (HA), which allows the rescue of the perception of speech sounds, beyond the environmental sounds, promoting improvement of communication skills (13).

This study aims to examine the benefit of hearing about the location during activities of daily living in individuals with unilateral hearing loss from mild to profound fitted with hearing aids Individual (HA).

Method

The procedures for selection and evaluation of the patients were started after approval by the Ethics Committee (protocols 15/2007 and 297/2006) and signing the consent form.

This cohort study contemporary cross-sectional was conducted with 31 adults aged between 18 and 75 years and both genders (19 males and 12 females).

Inclusion criteria were that participants:

- Age groups: adults and elderly (18-75 years).
- Hearing loss (HL) sensory neural, mixed or conductive to varying degrees.
- Contralateral hearing within normal limits.
- No experience with the use of hearing aids to first application of the questionnaire.
- Effective use of hearing aids for at least six months for a second application of the questionnaire.

The degree of hearing impairment was classified using the audiometric thresholds of 500, 1,000, 2,000 and 4,000 Hz: mild (average 26-40 dB HL), moderate AD (average 41-60 dB HL) and severe (mean 61 80 dB HL) and depth (average above 81 dB HL), according to WHO (14).

The data were collected to be identified as age, type and degree of hearing loss, fitting time and daily use of hearing aids (Annex 1).

To evaluate the location of the sound source in daily activities, we used the Portuguese version of the questionnaire validated by Ruscetta et al. (12)

Anexo 1. Protocol for data collection.

Gender: ( ) F ( ) M	Age: ___ years			
( ) With HA	( ) Without HA			
Tipo de Perda Auditiva:	( ) Conductive	( ) Neuro sensory	( ) Mixed	
Grau da Perda Auditiva:	( ) Weak	( ) Moderate	( ) Severe	( ) Deep
Time of adaptation of the HA:	( ) 6 months	( ) 6 months to 1 year	( ) 1 - 2 years	( ) more than 2 years
Time of daily use of the HA:	( ) 2 - 4 hours	( ) 4 - 8 hours	( ) more than 8 hours	
Obs:				

Table 1. Variable by separate groups for the Kruskal-Wallis.

Variable	Group 1 (G1)	Group 2 (G2)
Age	18 - 43 years	44 - 75 years
Hearing loss degree	Weak and Moderated	Severe and Deep
Time of adaptation of the HA	6 months to 1 year	More than 1 year
Time of daily use of the HA	2 to 8 hours	More than 8 hours
Hearing loss type	Conductive and mixed	Neuro sensory

The instrument consists of 14 questions related to the location of the sound source in daily activities (Annex 2), applied individually by the same examiner on two occasions: with and without the use of hearing aids.

The questionnaire has four response options being "never" "sometimes," "usually" and "Always." Each answer is assigned a value of one to four, to an alternative number we adopted a weight (1) for alternative 2: weight two (2) for third alternative: weight three (3) and Alternative 4: four weight (4). As the value 4 (four) indicating lower degree of difficulty.

The subjects answered a questionnaire on the day that would be adapted to hearing aids, ie without previous experience in the use of amplification and after the minimum period of six months with the effective use of hearing aids the second session of the questionnaire.

To perform the statistical study sample was divided into two groups and the G1 made by individuals with hearing loss and sensory neural aged 44-75 years, and G2 comprised of individuals with AD and mixed conductive and age group 18-43 years (Table 1).

Results

The average response obtained in the questionnaire according to the type and degree of hearing loss, fitting time and daily use of hearing aids were calculated

The statistical non-parametric *sign test* (15) was used to identify a possible difference in auditory localization with and without the use of hearing aids (minimum level of significance 1%).This test is based on the median difference between the two situations: with and without hearing aids, if the median is statistically equal to zero the two groups did not differ.

The non-parametric test of Kruskal-Wallis (15) aims to detect whether two or more independent samples are from the same population or different populations. Table 1 was applied to detect a possible difference in assessing the benefit to hearing aid use for the variables: age, type and degree of hearing loss, fitting time and daily use of hearing aids. To apply the test variables mentioned above were separated into two groups. It was adopted minimum level of significance of 10% ($p < 0.10$).

In Table 2 are distributed to the averages of responses obtained in the questionnaire according to the type and degree of hearing loss, fitting time and daily use of hearing aids and age of individuals.

From the sign test was found statistically significant difference (significance level less than 1%) for the results obtained in the questionnaire on the auditory localization with and without hearing aids. The median estimate for the difference was 1.6 and the confidence interval was (0.9, 1.8) (Figure 1).

The Kruskal-Wallis test (Table 3) indicated no significant difference in benefit for the auditory localization between G1 and G2 (Tables 1 and 2) according to the variables age, type of hearing loss, hearing loss, time the fitting of hearing aids and daily use of hearing aids.

Discussion

Whereas individuals with the same audiometric

Annex 2. Questionnaire about difficulties and limitations associated with the location of hearing.

1. You're at home in a quiet room. There are other people in the house. They are talking in another room and you can hear them. You can tell which part of the house are these people?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always
2. You turn the wrong way when someone you cannot see you called?
   1. ( ) Always 2. ( ) Usually 3. ( ) Sometimes 4. ( ) Never
3. You're in a place that is unfamiliar. Someone you cannot see is pruning the grass with the machine. You know where the sound is coming from?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always
4. You're sitting around a table or at a meeting with several people. There is background noise. You find it hard to know who are?
   1. ( ) Always 2. ( ) Usually 3. ( ) Sometimes 4. ( ) Never
5. You're in a house that is not familiar. It's quiet and suddenly hears a door slam. You can tell which part of the house came the sound?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always
6. You're in an apartment or an office building and hear a sound from another floor. You can tell if the sound is coming from below or from the top of where you are?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always
7. You're on a sidewalk of a busy street. A car horn. Do you have trouble telling which direction the car coming?
   1. ( ) Always 2. ( ) Usually 3. ( ) Sometimes 4. ( ) Never
8. You are "out of doors" A dog barks loudly. You can tell where the dog without looking?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always
9. You're on the sidewalk of a busy street. You can tell which direction a bus or a truck is coming before you see it?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always
10. On the street, you can judge how far someone is from the sound of the voice or the floor of that person?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always
11. You're on the outside of a place that is unfamiliar. Someone called from somewhere above you (like a balcony or a bridge). You find it hard to tell where the voice is coming from?
   1. ( ) Always 2. ( ) Usually 3. ( ) Sometimes 4. ( ) Never
12. You're on the sidewalk of a busy street. You can tell just by the sound, which distance the bus or truck is?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always
13. You are the "outdoors". You can hear an airplane. You think it's hard to say where the plane is in heaven, only by the direction of the sound?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always
14. If you have difficulty locating the sound, would help you if you move to find the direction of the sound?
   1. ( ) Never 2. ( ) Sometimes 3. ( ) Usually 4. ( ) Always

Table 2. Averages of responses obtained in the questionnaire according to the type and degree of hearing loss.

	With HA	Without HA
Use time between 6 months and 1 year	3.17	1.90
Use time greater than 1 year	3.25	1.79
Sensory neural hearing loss	3.18	1.79
Mixed hearing loss / conductive	3.32	1.94
Degree of hearing loss weak / moderate	3.35	1.96
Degree of hearing loss severe / deep	3.05	1.67
Use time 2-8 hours / day	3.16	1.85
Use time more than 8 hours / day	3.26	1.83
Aged between 18 and 43 years	3.31	2.06
Aged between 44 and 75 years	3.01	1.56

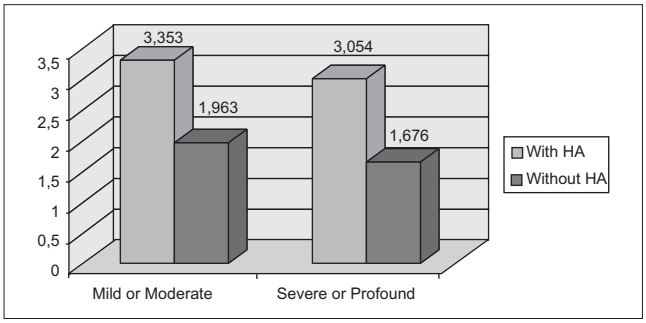

Figure 1. Mean of scores on the questionnaire, with and without HA, according to the hearing loss degree.

profile have different perceptions of their problem and that the traditional audiometric tests provide only basic information about the hearing abilities of the individual, it - is essential to assess the difficulties of communication, location, social and emotional disabilities hearing through the use of questionnaires (16).

The difficulty in locating sound can express in daily life situations. As regards the distribution of responses obtained without the use of HA was observed that there was difficulty in locating similar in different types and degrees of hearing loss (Table2), and after the use of hearing aids for a minimum period of six months was a statistically significant improvement for all variables considered, most notably the loss of mild / moderate. From these data we can observe that the difficulty increases as the hearing sensitivity worsens.

The difference in time of reception of sound by two ears is what makes the first stimulated ear indicating the direction of the sound source. Thus, a sound that originates, for example, the right of a listener first come to the right ear, which is closer to the sound source and, after a brief interval, reach the left ear, which is farther away (17) .

As the results, you can see the benefit with the use of hearing aids for auditory localization in accordance with the time of use and adaptation of the device, thus the sensitivity of subjective measures, such as questionnaires, examining the progressive improvement of listening skills, among them, the auditory localization in the period that follows the adaptation of hearing aids it is important. In a retrospective survey questionnaires given to parents of 20 children with unilateral hearing loss tailored to HA were observed at 72% of positive responses regarding the benefit of it specifically related to hearing ability in different environments (18).

Researchers performed an evaluation of the benefit of amplification in 29 individuals with unilateral hearing loss by means of questionnaires Abbreviated Profile of Hearing Aid Benefit (APHAB), Glasgow Hearing Aid Benefit Profile (GHABP), International Outcome Inventory for Hearing Aids (IOI-HA) and *Single-Sided Deafness Questionnaire*. Improvement was observed in the localization of sounds after adjusting the sound amplification device demonstrating the minimization of the head shadow effect. According to the questionnaires used, after a year of monitoring individuals were satisfied with the amplification (19).

Researchers who scored the biggest success of treatment of 57 subjects with unilateral hearing loss with communication difficulties were related to higher early intervention (surgery or amplification) (20).

Table 3. Statistics and H p-value computed for a Kruskal-Wallis.

Variable	Statistic H	p-value calculated
Age	1.51	0.22
Degree of Hearing Loss	0.02	0.88
Time Adaptation of HA	0.41	0.52
Time Use Diary HA	0.01	0.93
Type of Hearing Loss	0.05	0.82

Because the binaural hearing is a process, the brain, through the comparison of the two auditory inputs can solve acoustic complexities, determine the direction of sound and perfect a relevant signal in the presence of other sounds and noises (21). According to the results we see that 61% of the sample made effective use of hearing aids, using the same for more than eight hours daily and 39% 2-8 hours per day, thus suggesting that the possibility of binaural hearing and consequently the ease of sound location was significant in this population.

Thus, there is the importance of using these questionnaires, which makes it possible to investigate the patient's perception about the difficulties of communication, helping to monitor over time and identifying the real auditory needs beyond those possible to be observed in the audiological assessment of routine (22,23).

Finally, the findings of this study showed the importance of research of the difficulties imposed by unilateral hearing loss and rehabilitation benefits in these cases with the use of amplification. The emergence of neonatal screening programs and early detection of infants with this type of hearing loss that were previously neglected become imperative that professionals are prepared for appropriate monitoring and intervention (24).

Conclusion

Benefits were observed on the auditory localization during activities of daily living with use of hearing aids, and revealed that there was variability according to the type and degree of hearing loss, duration of daily use and adaptation time of the hearing aid.

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