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Original articles

Unilateral hearing loss and the use of hearing aid: speech recognition, benefit, self-perception of functional performance and satisfaction

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ABSTRACT

Purpose: to investigate speech recognition in silence and in noise in subjects with unilateral hearing loss with and without hearing aids, and to analyze the benefit, self-perception of functional performance, satisfaction and the use of hearing aids in these subjects.

Methods: eleven adults with unilateral, mixed and sensorineural, mild to severe hearing loss participated in this study. Speech recognition was evaluated by the Brazilian Portuguese sentences lists test; functional performance of the hearing was assessed by using the Speech Spatial and Qualities of Hearing Scale questionnaire; satisfaction was assessed by the Satisfaction with Amplification in Daily Life questionnaire, both in Brazilian Portuguese; and to assess the use of hearing aids, the patient's report was analyzed.

Results: the adaptation of hearing aids provided benefits in speech recognition in all positions evaluated, both in silence and in noise. The subjects did not report major limitations in communication activities with the use of hearing aids. They were satisfied with the use of sound amplification. Most of the subjects did not use hearing aids, effectively. The discontinuity of hearing aids use can be justified by the difficulty on perceiving participation's restriction caused by hearing loss, as well as the benefit of the hearing aid, besides the concern with batteries' costs and aesthetic aspects.

Conclusion: although showing benefits in speech recognition, in silence and in noise, and satisfaction with sound amplification, most subjects with unilateral hearing loss do not effectively use hearing aids.

Keywords: Hearing Loss Unilateral; Hearing Aids; Speech Perception; Questionnaires

INTRODUCTION

Unilateral hearing loss (UHL) was historically underestimated, but nowadays it is the subject of several studies[1-5], due to its occurrence being more common and because it presents the most adverse effects of what was previously believed. According to these studies, the traditional thought that only the normal ear would be enough to supply the needs of daily communication, is giving up space for the valorization and real importance of the effects of UHL.

Subjects with UHL may present academic and communication difficulties, especially in noisy environments, problems in language and pronouncing speech sounds, deficits in central auditory processing, as well as social and emotional difficulties[1,4,6]. These difficulties are related to the lack of binaural hearing, which is the natural condition of the hearing[7]. Binaural hearing provides a better localization of the sound source, binaural summation, elimination of the shadow effect of the head, ability to separate target sounds from environmental noise and better speech recognition in noise[7].

Thus, to minimize the effects caused by this type of sensory deprivation, the Ministry of Health recommends the use of conventional hearing aids, in cases of UHL that present residual hearing capable of sound amplification[8].

Although the adaptation of hearing aids is recommended for the subjects with this type of sensory deprivation, this device may present limited efficiency, especially in adverse situations of communication, such as, in noisy environments or with reverberation[5-9].

Subjects with UHL present specific complaints regarding the difficulty of understanding speech, especially when the speech is mostly received by the worst ear, or in situations with competitive noise, greater effort to hear and also difficulty in locating the sound source[2].

Thus, the situations in which they report difficulty are quite inconstant, which makes it difficult for them to perceive their own difficulty on daily life communication, such as, it is also difficult to the professional who works with them to scale their difficulties and to adapt the rehabilitation strategies of these subjects. This occurs because the contralateral ear has normal hearing and its performance is satisfactory in favorable listening situations, which are situations in a silent environment and situations in which the sound is incident on the side of the best ear.

Thus, even with appropriate guidance and follow-up, since they believe that the normal ear would be enough to meet their needs of daily communication, these subjects interrupt the use of hearing aids, and they remain being unilateral listeners[2]. Moreover, subjects with this type of sensory deprivation may discontinue the use of hearing aids, due to lack of benefit, discomfort generated by sound amplification, or still due to the interference that may occur in the best ear, in the cases when great amplification is necessary in the hearing impaired ear adapted to an hearing aid, in greater hearing losses[9].

However, in cases of long periods of sensory deprivation, whether partial or complete, a phenomenon known as auditory deprivation may occur, which is generated by the non-use of the hearing aid in the worst ear[10], and which is observed by the worsening of the recognition of speech in the unstimulated ear.

In the consulted literature, there are several studies[2,4,11] that investigated the effects of sensory deprivation on UHL, and its impact on quality of life. On the other hand, there is a gap in the literature regarding aspects related to benefit, satisfaction and time of use of hearing aid adaptation as a way of treatment used in such cases.

Thus, in order to enable and improve the adaptation of these subjects to a hearing aid, researches are needed to contribute to the comprehension of the characteristics and aspects involved in this process of adaptation[5], besides assisting in the choice of appropriate procedures to perform the verification and validation process of hearing aid adaptation in this population.

Thus, this study's objective was to investigate speech recognition in silence and in noise in subjects with UHL, with and without hearing aids, and to analyze the benefit, self-perception of functional performance, satisfaction and the use of hearing aids in these subjects.

METHODS

It is a study with documental analysis and development of the prospective, transversal and quantitative type, which had as clinical outcome the observation and analysis of aspects related to the use of hearing aids in subjects with UHL, such as, performance, benefit, satisfaction and time of use of the hearing aid. The study is part of a research project "Hearing disorders: evaluation and intervention", approved by the Research Ethics Committee of Universidade Federal de Santa

Maria, under the number 05765712.3.0000.5346 and which has complied with the guidelines and regulatory standards of Resolution No. 466/2012[12].

The sample of this study was assembled for convenience. Initially, a survey was conducted in the database of the Laboratory of Hearing Aids of the university, seeking to select participants according to the eligibility criteria.

The following inclusion criteria were established: signature of a ~~the Informed~~ Consent Form; diagnosis of conductive, mixed or sensorineural unilateral hearing lossl[13], from mild to severe[14]; to be part of the Federal Government's Hearing Aid Concession Program and to have received the hearing aid (unilateral adaptation) between January 2009 and September 2017, being this the first experience with hearing aids; having received the hearing aid with digital technology; having performed the adaptation of the hearing aid for at least three months, this being considered the acclimatization period[15]; being 18 years old or older. As exclusion criteria was defined: to present evident neurological, emotional and/or cognitive impairment, diagnosed or not, that could interfere in the responses of the tests used, such as memory problems, cerebrovascular accident, dementia, among others; and/or verbal fluency impairment.

Thus, 78 subjects with UHL were selected in the period considered. Of these, 47 were candidates according to the parameters specified by the Ministry of Health[8] and have received a hearing aid by the Brazilian Unified Health System (BUHS). After selecting the subjects, contact attempts were made via telephone, in different days and times, to schedule a follow-up, but of the 47 subjects, it was possible to establish contact only with 24, and among these, only 11 have accepted to take part in the research.

Thus, the sample consisted of 5 female subjects (45.45%) and 6 male (54.55%). Age average was of 55.64 years old. Of these, 3 subjects (27.27%) had sensorineural hearing loss and 8 (72.73%) had a mixed type. From these 1 (9.09%) was mild, 4 (36.36%) moderate, 3 (27.27%) moderately severe and 3 (27.27%) severe.

Data related to the adaptation of the hearing aid in the medical records revealed that these subjects were adapted with retroauricular hearing aids, of several brands, with digital technology, with noise reduction and microphonic noise cancellation, compulsorily triggered, and possibly with more specific resources that varied according to each hearing aid model, according to the availability of the Official Note in the year in which they were adapted. For the programming of hearing aids, the nonlinear prescriptive method called NAL-NL1[16] was used. In general, the average time of adaptation of the hearing aid of the subjects evaluated was of 2 years.

The procedures performed in this study were initially the application of a directed anamnesis, developed by the researcher with the intention of providing information regarding the process of adaptation of the hearing aid, Then, it was performed the visual inspection of the ear canal and then, the investigation of hearing thresholds on both ears.

Then, the subjects were submitted to the investigation of Sentence Recognition Threshold in Silence and in Noise (LRSS and LRSR) and Percentage Index of Sentence Recognition in Silence and in Noise (IPRSS and IPRSR); Application of the Speech, Spatial and Qualities of Hearing Scale (SSQ) in Brazilian Portuguese[17]; Application of the Satisfaction With Amplification in Daily Life (SADL) in Brazilian Portuguese[18]; and investigation of the time of use of the hearing aid.

Obtaining the sentence recognition threshold and percentage index in silence and in noise

LRSS, LRSR, IPRSS and IPRSR have been obtained by means of the test Lists of Sentences in Brazilian Portuguese (LSP-BR)[19-21], consisting on a list of 25 sentences, seven other lists with 10 sentences and a noise in speech spectrum. Sentences and noise have been recorded in digital format on a Compact Disc (CD), in independent channels, allowing the levels of presentation of the stimuli to be separately adjusted.

Participants of the research have been evaluated both in silence and in noise, in binaural condition, in sound field, initially without the hearing aid and later with the hearing aid. Evaluation has been carried out in an acoustically treated cabin using a two-channel digital audiometer of the Fonix brand, model FA-12, and an amplification system for audiometry in sound field, model TA 1010. Sentences have been presented using a Toshiba brand CD player, model 4149, in the line out option coupled to the audiometer.

Measurements have been obtained with the subject positioned at one meter from the speakers. In silence, the speech was placed in 90º azimuth (speech positioned towards the side of the worst ear). As for the noise, this one was positioned in different angles of

occurrence (0º / 0º azimuth - speech and noise falling in the same direction and 0º / 90º better ear - speech occurring on front and noise positioned on the side of the best ear).

Positions of signal and noise in these angles of occurrence has been established seeking to represent and evaluate subjects' performance with UHL in daily situations of greater difficulty experienced by this population such as when speech goes towards the side of the worst ear and when noise occurs on the side of the best ear[4].

To determine ~~the~~ sentence recognition thresholds, the sequential or adaptive or even ascending-descending strategies[22] have been used, as well as 5 dB stimulus presentation intervals until perceiving change in response and then 2.5 dB due to equipment availability. Means of LRSS or LRSR have been calculated from the level of presentation in which the first incorrect response occurred, up to the level of presentation of the last sentence in the list. For IPRSS and IPRSR, sentence presentation levels were set in the mean values in which LRSS and LRSR have been obtained for each subject.

During measurements in noise, it remained constant at the level of 65 dB NPS (A).

For calculation of IPRSS and IPRSR, the protocol of word punctuation in the sentence was used, which allows to determine in a more detailed fashion and with less variability each subject's real ability to recognize speech[23].

Giving the questionnaires

Questionnaires were given as an individual interview to ensure the whole completion and adequate understanding of questions.

To assess subjects' performance in relation to self-perception of auditory performance with the use of hearing aids, the SSQ (Speech, Spatial and Qualities of Hearing Scale) questionnaire was used in Brazilian Portuguese[17].

Questions 16 and 17 of Auditory Qualities scale, which are related to hearing within a motor vehicle, were excluded from the analysis, since they were not experienced by all subjects assessed and also because they vary according to the hearing loss side.

Regarding satisfaction with the use of hearing aids, this was evaluated through the SADL (Satisfaction with Amplification in Daily Life) questionnaire in Brazilian Portuguese[18].

Question 11 of the questionnaire, which is related to the difficulty of hearing in telephone use was excluded from the analysis, since subjects with UHL use the best ear to speak on the telephone.

As for Question 14, which is related to the cost of the hearing aid, it was adapted to: "Does spending money on batteries and travel (tickets, meals) for monitoring the hearing aid adaptation seem reasonable to you?", since subjects received the hearing aid free of charge from BUHS.

Evaluation of the time of use of the hearing aid

The time of the hearing aid use was investigated by means of the anamnesis directed and confirmed by recorded data of the hearing aid, when this resource was available.

It was considered effective the use of hearing aid when the subject's report or the recorded time of use indicated at least 8 daily hours[24].

Data Analysis

After all data collecting procedures, the information collected was tabulated, and then analyzed and compared, descriptively and through inferential statistics, according to the proposed objectives. For statistical analyses, the Statistica 9.1 program was used.

The statistical tests used were the Student's t test for dependent samples and normal distribution observed from the normality test and the non-parametric Wilcoxon test used in the analysis of non-normal variables. It was considered a significant result $p \leq 0.05$, with 95% confidence interval.

RESULTS

Initially, the descriptive analysis of the subjects performance without the hearing aids, obtained based on the LRSS and LRSR, is presented, the latter expressed by the signal/noise ratio (S/R), which is the difference between the levels of presentation of the stimuli of speech and noise (65 dB NPS (A)).

Table 1. Performance of subjects with unilateral hearing loss without hearing aids, speech recognition in silence and noise, in different positions evaluated by means of the LSP-BR test (n = 11)

Assessment situation	Average	Minimum	Maximum	Standard deviation
LRSS (90˚) (dB NPS (A))	31.86	26.92	40.55	4.12
S/N ratio (0˚/0˚)	-5.50	-8.75	-1.00	2.77
S/N ratio (0˚/90˚)	-3.53	-7.56	+2.50	2.87

Legend: LRSS: Sentence Recognition Threshold in Silence; S/N ratio: Signal-to-noise ratio; (90˚): Speech focusing on the side of the worst ear; (0˚/0˚): Speech and noise focusing on the front; (0˚/90˚): Speech focusing on front and noise side of the best ear.

In Table 2, it can be observed the performance in speech recognition, with the use of different evaluation strategies, without and with hearing aids.

In Table 3, it is possible to observe the results obtained through the SSQ questionnaire, which scales the self-perception of functional auditory performance, with the use of hearing aids by subjects with UHL.

Table 2. Average performance and standard deviation of different measures of speech recognition, in silence and noise, obtained at different angles of incidence, with and without the use of hearing aids, and statistical result of the comparison between the measures (n = 11)

Assessment situation	Average	Minimum	Maximum	Standard deviation	Comparison between S/PA and C/PA
					P value
LRSS (90˚) S/PA (dB NPS (A))	31.86	26.92	40.55	4.12	< 0.01*
LRSS (90˚) C/PA (dB NPS (A))	28.44	25.50	35.33	2.96	
IPRSS (90˚) S/PA (%)	61.27	56.89	65.93	3.05	< 0.01*
IPRSS (90˚) C/PA (%)	84.25	70.09	96.49	7.68	
LRSR (0˚/0˚) S/PA (dB NPS (A))	59.50	56.25	64.00	2.77	< 0.01*
LRSR (0˚/0˚) C/PA (dB NPS (A))	55.80	53.64	58.92	1.46	
S/N ratio (0˚/0˚) S/PA	-5.5	-8.75	-1.00	2.77	< 0.01*
S/N ratio (0˚/0˚) C/PA	-9.19	-11.36	-6.08	1.46	
IPRSR (0˚/0˚) S/PA (%)	62.25	55.48	67.08	3.66	< 0.01*
IPRSR (0˚/0˚) C/PA (%)	81.45	72.60	92.20	6.61	
LRSR (0˚/90˚) S/PA (dB NPS (A))	61.47	57.44	67.50	2.87	< 0.01**
LRSR (0˚/90˚) C/PA (dB NPS (A))	57.84	55.05	61.75	2.64	
S/N ratio (0˚/90˚) S/PA	-3.53	-7.56	+2.50	2.87	< 0.01**
S/N ratio (0˚/90˚) C/PA	-7.25	-9.95	-3.25	2.67	
IPRSR (0˚/90˚) S/PA (%)	60.63	50.06	66.71	5.00	< 0.01*
IPRSR (0˚/90˚) C/PA (%)	78.11	67.35	88.90	6.24	

Significance level (p≤0.05); *Paired Student's T-test; **Wilcoxon Test.

Legend: LRSS: Sentence Recognition Threshold in Silence; IPRSS: Percentage index of sentence recognition in silence; LRSR: Sentence recognition threshold in noise; IPRSR: Percentage index of sentence recognition in noise; S/N ratio: Signal-to-noise ratio; (90˚): Speech focusing on the side of the worst ear; (0˚/0˚): Speech and noise focusing on the front; (0˚/90˚): Speech focusing on front and noise side of the best ear; S/PA: Situation without hearing aid; C/PA: Situation with hearing aid.

Table 3. Results of the SSQ questionnaire, in subjects with unilateral hearing loss, with the use of hearing aids (n = 11)

Subscale	Average	Medium	Minimum	Maximum
Speech hearing	6.88	7.00	5.85	7.85
Spatial hearing	7.80	7.82	6.24	8.94
Qualities of hearing	7.72	7.81	6.44	8.63
Global	7.53	7.69	6.25	8.17

The results found with the application of the SADL questionnaire can be observed below. It evaluates the satisfaction of the subject with the use of the hearing aid (Table 4).

In Table 5 is presented the data on the use of the Hearing Aid. By looking to the responses of the directed anamnesis, it was possible to observe that participants who did not make effective use of the hearing aid, did not actually use it at any time or used an average of 2 hours per day, on specific occasions of greater communicative demand.

Table 4. Results of the SADL questionnaire, in subjects with unilateral hearing loss, with the use of hearing aids (n = 11)

Subscale	Average	Medium	Minimum	Maximum
Positive Effects	6.06	6.33	3.00	6.83
Services and Costs	6.91	7.00	6.33	7.00
Negative Factors	2.45	2.00	1.00	4.50
Personal Image	3.67	3.00	2.33	5.67
Global	5.21	5.14	4.29	6.14

Table 5. Use of hearing aids

	N	Percentage (%)
Made effective use	3	27.27
Didn't make effective use	8	72.73
Total	11	100

Legenda: N: número de sujeitos

The descriptive analysis of the aspects that demotivated the subjects to continue the use of the hearing aid shows that: 1 (12.5%) of the subjects claimed the non-perception of benefit in daily life, 3 (37.5%) claimed self-sufficiency in daily communicative situations generated by the ear with normal hearing, 2 (25%) batteries costs, 3 (37.5%) fear of damaging the hearing aid and 3 (37.5%) aesthetic aspects.

DISCUSSION

Performance here was considered as the subject's output during all speech tests without the hearing aid. The benefit was considered from the analysis of the change perceived after the adaptation of the hearing aid in speech tests performance with and without the hearing aid. Satisfaction was considered based on the subject's self-perception about the outcome of hearing aid adaptation, which include a range of factors assessed by the questionnaire, according to the needs and perceptions of the benefit of each subject. The use of hearing aids was analyzed according to the time of daily use of the hearing aid.

Before the analysis of the subjects' performance using the hearing aid, it was considered important to present and discuss the communicative performance of the subjects without its use.

Initially, we considered the measures obtained in silence that represent favorable listening situations, in which rarely the subjects with UHL complain or have difficulties. Thus, to scale the influence of UHL, even in situations of silence, the LRSS were obtained with the speech directed to the worst ear (Table 1), without occluding the ear with normal hearing, in order to simulate a real situation of communication, having as LRSS result at an average level of stimulus presentation of 31.86 dB NPS (a).

In order to measure if subjects with UHL, since they have normal hearing in one ear, presented similar performance to the normo-hearing subjects in silence, results published in other studies that determined the LRSS measurements in subjects with normal hearing, using a similar research methodology (LSP-BR or

Hearing in Noise Test (HINT-Brazil)) were analyzed. When observing these findings, it was possible to verify that the LRSS found in the present study were higher than those obtained in studies with subjects with normal hearing. In these studies, loudspeakers were positioned in front of the subjects, as we can observe: 14.5 dB NPS (A)[25]; 15.3 dB NPS (A)[26]; 17.15 dB NPS (a)[27] and 23.61 dB NPS (a)[28], which shows that even in silence, when speech is directed towards the impaired ear, some low intensity sounds will not be recognized without amplification.

Later, noise measurements were obtained. They represent unfavorable listening situations in which subjects with UHL complain and perceive their greatest speech recognition difficulties.

When analyzing measurements obtained in noise, it can be observed in Table 1 that subjects evaluated in this study presented LRSR in a mean S/R ratio of -5.50 when evaluated with speech and noise frontally occurring and compared to normal-hearing subjects observed in other studies, which found an average S/R ratio of -7.57[29] and -8.14[30] using the same method and evaluation material. These findings show that even with one ear presenting normal hearing, in unfavorable listening situations UHL interferes negatively in speech recognition when speech and noise originate from the same direction.

Also, in the present study, when subjects were evaluated with frontally occurring speech and ear-side noise with normal hearing, an even more favorable S/R ratio was required, this being -3.53. This shows marked difficulty in speech recognition when compared to the study conducted with normally hearing subjects[29], who obtained S/R ratios of -11.12 for the right ear and -10.43 for the left ear when assessed in the same situation with speech presented frontally and noise lateralized to one of the ears.

Results found in this study are in agreement with others performed[5-31] with subjects with UHL that evaluated speech recognition, both in silence and in noise, using the Brazil HINT test. Values observed demonstrated that subjects with this type of loss may present limitations to listening to low intensity sounds in silence and speech recognition difficulty in presence of competitive noise when the message and the noise are frontally presented. This difficulty being accentuated when noise strikes the ear with normal hearing, as can be seen in the Figure below.

	In this research	SEKSENIAN (2015)[31] RE / LE	MONDELLI, SANTOS and JOSÉ (2016)[5] – RE / LE
LRSS dB NPS (A)	31.86	37.91 / 44.69	40.18 / 41.01
S/N ratio (0°/0°)	-5.50	-0.34 / -0.79	-0.70 / -1.50
S/N ratio (0°/90°)	-3.53	1.02 / 0.39	-0.36 / -2.38

Legend: LRSS: Sentence Recognition Threshold in Silence; S/N ratio: Signal-to-noise ratio; (0°/0°): Speech and noise focusing on the front; (0°/90°): Speech focusing on front and noise side of the best ear; RE: Right ear affected by hearing loss; LE: Left ear affected by hearing loss

Figure 1. Comparison between the findings described in Table 1 and other studies investigating the speech recognition of subjects with unilateral hearing loss

Individuals with UHL present speech recognition difficulties in the presence of competitive noise, especially when the noise is perceived in the normal hearing ear due to noise interference and consequent decrease of participation of the normal ear , which has a crucial function in communicative performance of subjects with UHL[5-31], which was proven in this study, as described in the results.

From these data, it is observed that limitations imposed by UHL vary not only in degree but also in individual characteristics, abilities and needs, which reinforces the prescription of hearing aids in order to assist subjects in their activities, minimizing limitations caused by this sensory deprivation, already discussed in this study. Nevertheless, the real benefit of hearing aids in this population still raises doubts among professionals[5-32], mainly due to the instability of communication situations in which subjects present difficulty, which makes it difficult to perceive benefits and, consequently, motivation for using hearing aids. Thus, in order to measure this benefit, subjects participating in this research were submitted to speech recognition evaluation with and without hearing aids by using the LSP-BR test.

Sentence recognition tests in noise are considered critical instruments in evaluating these patients because they assess hearing abilities in scenarios that are similar to daily auditory experiences[33]. When presented in sound field, they evaluate speech recognition in binaural conditions[34] and it is possible only in this situation to size communicative difficulties of subjects with UHL and make sure that hearing aids are actually providing benefit to users, which may not be always happening.

Use of tests with sentences as a stimulus both in silence and in noise allow dimensioning effects of the use of hearing aids in communication situations besides allowing patients a more real vision of the hearing aid effect, serving as an encouragement to the use.

Thus, based on Table 2 it was possible to observe that the adaptation of hearing aids in subjects with UHL provided better speech recognition performance in all positions evaluated, in silence and in noise, both in relation to the threshold and the percentage index, showing values of audibility and intelligibility similar to those reported in other studies with subjects with normal hearing[29,30].

In a study[5] that has also evaluated subjects with moderate to severe neurosensory type UHL and hearing aid use by using the Brazil HINT test, the authors reported having found subtly better responses with hearing aid use in the population evaluated, both in silence and noise.

In another study[9], in which hearing aid adaptation in subjects with moderate to severe neurosensory type UHL was investigated by using the Word Recognition Scores (WRS) and Quick Speech in Noise Test (QuickSIN) tests, the authors observed that this type of intervention presented some challenges, as hearing aids caused worse performance in speech recognition in some situations. There was a slight worsening of results related to speech recognition with the use of hearing aids, when participants of the study being evaluated in silence with the WRS (word recognition score) test. Concerning the perception of speech in noise, evaluated with QuickSIN and using hearing aids, when evaluated with speech and noise frontally occurring and when speech was directed to the side of the best ear and the noise directed to the side of the ear with hearing loss, subjects presented worse performance in speech recognition. In both cases, probably the resources available in the hearing aid were not enough to minimize effects of noise, which should have been amplified by the hearing aid and thus negatively influenced performance in these situations. However, subjects evaluated presented considerable benefit with adaptation of hearing aids when speech was directed to the worst ear and noise was directed to the best ear.

These researchers have also reported that reduction in speech recognition with the use of hearing aids, although statistically significant, has not produced impacting effects in subjects' communicative situations measured through results from self-assessment questionnaires.

These data have shown that noise amplification in the ear with sensory deprivation is a factor rarely considered during the process of hearing aid adaptation. This situation should serve as a warning for the need for greater attention during hearing aid adjustment, emphasizing the importance of effectively using noise reduction algorithms available in hearing aids. Therefore, it would increase the possibility of sound amplification to assist subjects in different communicative situations, with speech and noise focusing different angles.

Another aspect to be considered in these cases is the qualitative difference of the hearing information coming from the hearing aid and also from the ear with normal hearing. Subjects who receive stimulation from different sources experience very asymmetric neural representations of sound. However, there is scientific evidence[7] that, despite this difference in sound quality between the ears of subjects with UHL, the use of hearing aids can generate favorable results with the use of long-term sound amplification due to reorganization in neural processing of auditory information. In order to facilitate this adaptation, the importance of gradual sound amplification is reinforced, complying with the period necessary for new reorganization of the auditory system as a whole in order to obtain real benefits from binaural hearing.

On the other hand, when analyzing results presented in Table 3, which evaluated the self-perception of auditory performance in relation to the use of hearing aids in complex listening situations, it was possible to observe that subjects presented greater difficulties in the following scales: Hearing to Speech, Hearing Quality and Spatial Hearing, respectively, evidencing that even with the use of hearing aids these subjects' main complaint is related to the ability to recognize speech in different communicative situations.

So far, there is no delimited SSQ score that can be used as a parameter for decision making. However,

authors[35] have suggested a cutoff point for the questionnaire reduced version in order to determine the limitation in communication activities using the performance of normally hearing subjects from 18 to 25 years of age plus two standard deviations from the mean. Therefore, as recommended by such authors, for the Hearing to Speech scale, scores below 6.84 were considered; for Spatial Hearing, scores below 6.14; for Hearing Quality, scores below 8.18; and for overall score, scores lower than 7.25, which would indicate a significant degree of hearing impairment or limitation of communication activity. Therefore, results from this research have demonstrated that subjects with UHL with hearing aid use, when compared with normally hearing subjects, presented only a slight limitation in the Hearing Quality scale, which is related to auditory experience in relation to segregation of sounds, identification, recognition, clarity and naturalness, musical perception and listening effort.

In a study[9] that used the SSQ questionnaire in subjects with moderate to severe neurosensory UHL, it was verified that the sound amplification reduced the self-perception of hearing limitations in complex situations in general and that the greatest magnitude of improvement was observed in the Hearing to Speech scale and the lowest one was observed in the Hearing Quality scale. These results suggest that hearing aids adaptation in this population assists in their main complaints, which is speech recognition in different communication situations.

With regard to the analysis of satisfaction with the use of hearing aids, evaluated by the SADL questionnaire in Brazilian Portuguese (Table 4), results have shown that subjects reported being satisfied with the competence of the professionals who assisted them in the service, with the expenses with the hearing aid and the number of repairs. It is important to note that, in this study, hearing aids and technical and professional assistance were provided free of charge by BUHS, with only the cost of batteries being borne by the patients. They have also reported being satisfied with acoustic and psychological benefits that hearing aid adaptation provides. On the other hand, they reported being less satisfied with aesthetic factors and the stigma that hearing aids generate to users as well as the amplification of environmental noise.

In a study[36] that investigated users' satisfaction with hearing aids granted by BUHS, with bilateral hearing loss of different types and degrees, responses to the SADL questionnaire showed that this population presented greater satisfaction in the Personal Image scale. This finding suggests that subjects with bilateral hearing loss believe that the use of hearing aids diminishes the perception of others in relation to their hearing loss, since their communicative performance with the sound amplification considerably improves when compared to their performance without hearing aids, thus valuing benefits and not aesthetic aspects.

This data is contrary to what was found in this study, since subjects with UHL presented lower satisfaction on this scale, which can be justified due to the fact that these subjects present satisfactory social performance, even if they do not use hearing aids, since the ear with normal hearing helps in communication, making the aesthetic aspects more valued than the benefit generated by the use of hearing aids.

Researchers have also investigated satisfaction from hearing aids users diagnosed with UHL by using the International Outcome Inventory for Hearing Aids (IOI-HA) and have observed positive answers to the questionnaire, demonstrating satisfaction with hearing aid adaptation[32].

Regarding the time of use (Table 5), the vast majority of the subjects evaluated in this study would not be using hearing aids, even presenting complaints related to UHL, speech recognition benefit, self-perception of improvement in daily communicative skills and satisfaction in most situations with the use of the hearing aid. These results corroborate those found by other researchers[37] who investigated the prevalence of UHL and the use of hearing aids in this population in the United States, who observed that only 11% of this population would use hearing aids.

Findings from this research also agree with results from another study[2] that shows that subjects with UHL or asymmetric bilateral hearing loss may discontinue the use of sound amplification due to lack of perception of benefits or because they believe that the normal ear would be sufficient to meet daily communication needs. Thus, these subjects interrupt the use of hearing aids, keeping as unilateral listeners.

In studies that have evaluated effective use of hearing aid in patients with UHL, after three months of adaptation, results showed that 66.67%[32] of the subjects evaluated, 61%[38], 59%[9] and 58%[3] effectively used hearing aids. However, in these studies the subjects were evaluated within a short period after adaptation of the hearing aid. If evaluated after this period, the number of effective users may be less over time and returns to service would be less frequent,

since discontinuation of hearing aid use has been observed as a trend in this population over time. For this reason, we believe that the need for professional monitoring is crucial to reinforce the importance and advantages of using them.

Among aspects justifying nonuse of hearing aids and discontinuation of treatment, subjects of this research mentioned: non-perception of daily benefits, self-sufficiency in daily communicative situations generated by the ear with normal hearing, expenses with batteries, fear of damaging the hearing aid and aesthetic aspects. Another point that should be considered is that subjects received the hearing aids from BUHS, free of charge, often not being part of their greatest interests, according to responses collected in the SADL questionnaire (question number 3) since in most situations hearing on the other ear would provide acceptable communicative performance. However, these subjects agreed to participate in the process of selection and adaptation of hearing aids because there were no costs and often because there was an expectation of improvement with the use of hearing aids, which, if not achieved after some time of use, would discourage them to continue using the devices on a day-to-day basis.

Another aspect that must be considered in relation to factors influencing the use of hearing aids in subjects with UHL is each subject's communicative demand. Subjects evaluated in this study had low communicative demands, which may have influenced the use of sound amplification, since subjects with this type of sensory deprivation present reasonable communicative performance in favorable listening situations.

The main function of hearing aids is to amplify speech sounds with the best possible quality. Technological advancement of digital hearing aids has provided sound quality so that subjects with hearing loss hear better[39]. However, this occurs mainly in silent environments. In situations with competitive noise, performance of subjects with UHL, even with the use of hearing aids, is still considered unstable and dependent on the angle of occurrence of speech and noise, this being one of the main factors that can result in abandoning the use of the hearing aid, together with other aspects, such as the stigma of its use, underestimation of sensory deprivation, lack of confidence in the benefits of sound amplification or unrealistic expectations with its use[39].

Thus, this research evidences the importance and need of speech-language pathologists to encourage hearing aids adaptation in this population, making sure that hearing aid adjustment is adequate to each subject's demands, emphasizing their periodic follow-up after an even more frequent process of hearing aid adaptation, seeking to guarantee effective use of hearing aids, thus reducing discontinuity of use and effects of hearing deprivation.

It is also believed that public services could provide tools allowing speech-language pathologists to carry out careful analysis of each case and real possibility of effective use of hearing aid. And in cases where it would be verified that patients would not present indications of effective adaptation, the hearing aid be returned to Laboratory of Hearing Aids of the university. This avoids financial and service waste and benefits other potential users who would be waiting for a long time, due to the large number of people who present hearing loss and the limited capacity of care in services covered by BUHS.

CONCLUSION

Subjects with UHL evaluated without auditory hearing aid presented limitations to listening to low-intensity sounds in silence when speech was perceived on the impaired ear. They also required more favorable S/R ratios to recognize speech in the presence of competitive noise, which was even more evident when noise was heard on the ear with normal hearing.

The use of hearing aids has provided benefits in speech recognition in all positions evaluated, in silence and in noise, both in relation to the speech recognition threshold and the percentage speech recognition index.

Subjects have not mentioned great limitations in communication activities with the use of hearing aids, although these subjects' main complaint was related to speech recognition in different communicative situations, even with the use of hearing aids.

Subjects were satisfied with the sound amplification provided by hearing aids.

Despite complaints about hearing loss, in addition to benefit and satisfaction with sound amplification, most of the adapted subjects do not effectively use the hearing aids.

Discontinuation in using the hearing aid may be justified by the difficulty of perceiving the limitation of participation, as well as the benefit of hearing aids on a day-to-day basis, besides the concern about costs of batteries, technical problems and aesthetic aspects.

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