

Treinamento auditivo: avaliação do benefício em idosos usuários de próteses auditivas****

Auditory training: assessment of the benefit of hearing aids in elderly individuals

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Abstract

Background: hearing impairment has a negative impact on communication. This impact can be minimized by hearing aids fitting and auditory training. Aim: to verify the effectiveness of auditory training in elderly individuals, new users of hearing aids, regarding the benefit in fitting. Method: forty-two individuals with mild to moderate neurosensorial hearing loss, ranging in age from 60 to 90 years, were selected. Individuals were new users of bilateral hearing aids and were divided in two groups: Experimental Group (EG) and Sham Group (SG). The EG was submitted to training in an acoustic cabin during six sessions. Both groups were assessed through the following tests: Speech in Noise, Dichotic Digits and the Abbreviated Profile of Hearing Aid Benefit Aphab self-assessment questionnaire, without the hearing aids, four and eight weeks after they were fitted. Results: there was a statistically significant difference between the groups in both of the used tests, and for the Abbreviated Profile of Hearing Aid Benefit Aphab in the second and third assessments in the sub-scales of: Communication Easiness, Reverberation and Environmental Noise. Conclusion: auditory training favored the improvement in the auditory processing abilities and benefited the hearing aid fitting process.

Key Words: Auditory Processing; Auditory Training; Elderly; Hearing Aids.

Resumo

Tema: a deficiência auditiva acarreta dificuldades na comunicação, as quais podem ser minimizadas por meio da adaptação de próteses auditivas e do treinamento auditivo. Objetivo: o objetivo geral deste estudo foi verificar a efetividade do treinamento auditivo em idosos novos usuários de próteses auditivas, quanto ao benefício no processo de adaptação. Método: foram selecionados 42 indivíduos, portadores de deficiência auditiva neurossensorial de grau leve a moderado, com idades entre 60 e 90 anos, novos usuários de próteses auditivas bilaterais, distribuídos em dois grupos: Grupo Experimental (GE) e Grupo Sham (GS). O GE foi submetido a um programa de treinamento auditivo em cabina acústica durante seis sessões. Ambos os grupos foram avaliados com os testes de Fala com Ruído, Escuta com Dígitos, e questionário de auto-avaliação *Abbreviated Profile of Hearing Aid Benefit* (APHAB), em três momentos: sem próteses (primeira avaliação), quatro semanas (segunda avaliação), e oito semanas (terceira avaliação), após a adaptação das próteses. Resultados: houve diferença estatisticamente significativa para os dois testes aplicados, e para o questionário Aphab (quanto ao benefício) na segunda e na terceira avaliações, nas sub-escalas: Facilidade de Comunicação, Reverberação e Ruído Ambiental. Conclusão: o programa de treinamento auditivo em cabina acústica foi efetivo com relação ao benefício durante o processo de adaptação das próteses auditivas.

Palavras-Chave: Transtornos da Audição/Reabilitação; Auxiliares de Audição; Adaptação; Idoso.

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Introduction

Auditory processing alterations can be defined as the deficit in processing auditory information, which may be associated with difficulties in speech comprehension in noisy and reverberant environments and with the identification and discrimination of sound patterns¹. The hearing abilities may be assessed through a battery of specific tests adapted to Brazilian-Portuguese². The auditory processing alterations may be rehabilitated through Speech-Language and Hearing Therapy or through auditory training.

According to literature reviews, one of the foundations of auditory training is the plasticity of the central nervous system - i.e. changes in morphology and auditory performance after training or rigorous hearing stimulation³. Neuro-plasticity may be developed through proposed tasks of auditory processing⁴.

Evidences have suggested that the central auditory system of the elderly individual is able to modify and that, with auditory training, the individual would learn to experience different sounds in a significant manner⁵.

Due to the lack of studies with the elderly population and the association of auditory training to the use of sound amplification, the purpose of this study was to assess the effectiveness of auditory training in this population, relating results of the auditory processing assessment with responses regarding the benefit obtained from the use of hearing aids.

Method

The sample consisted of 42 individuals (29 women and 13 men) aged between 60 and 90 years, with mild to moderate symmetrical bilateral sensorineural hearing loss⁶ who were candidates for the use of binaural hearing aids.

Selection of participants was based on the following criteria:

- . age range between 60 and 90 years;
- . mild to moderate symmetrical bilateral sensorineural hearing loss;
- . candidacy for the use of binaural hearing aids with digital technology;
- . no previous use of binaural hearing aids.

The exclusion criteria were unilateral hearing loss, unilateral adaptation of hearing aids and previous experience with the use of hearing aids.

It should be highlighted that brands and/or manufactures of hearing aids were not considered as criteria for inclusion and exclusion because the purpose of the current study was to assess the effectiveness of auditory training and not the quality of the equipments.

Data collection was performed at the Clinic of a public university located in the city of São Paulo. At this Clinic, all the Speech-Language and Hearing Pathology monitoring as well as the granting of hearing aids occurred with no financial cost to the participant.

The following equipments and materials were utilized during the development of the study: WelchAlly otoscope; clinical audiometer AC33 - Interacoustics, with TDH39 headphones; sound attenuating booth; compact disc player from Sony with direct input on the audiometer; laser compact disc (CD) containing the recording of the tests used - from the book "Central Auditory Processing: Assessment Manual"².

Consultation of the medical records of candidates for the use of binaural hearing aids was initially performed in order to investigate the possible participation in this study according to the inclusion and exclusion criteria.

Selected individuals were divided into two groups: Sham Group (SG), which consisted of individuals who, for whatever reason, were unwilling or unable to voluntarily participate in the auditory training program in a sound attenuating booth; and Experimental Group (EG), composed of individuals who accepted the invitation and voluntarily participated in the training program.

Both groups underwent monitoring for eight weeks after the hearing aids fitting and were assessed on three occasions: without hearing aids (first assessment session), four weeks after the hearing aids fitting (second assessment session), eight weeks after the hearing aids fitting (third assessment session).

In the first session, participants signed the consent form and underwent collection of clinical history, visual inspection of the external ear canal and application of the Aphab self-assessment questionnaire for which the interview was conducted by the researcher.

The Aphab questionnaire aims to quantify the difficulties experienced with the use of hearing aids in different situations of everyday communication. It consists of 24 items divided into four subscales: Ease of Communication (EC), Reverberation (RV), Environmental Noise (EN), and Sound Aversion

(SA).

The subjective benefit calculated from the responses obtained in the assessment sessions, with and without hearing aids, were considered to analyze the results of the Aphab questionnaire. In this case, positive values meant higher benefit whereas negative values indicated poorer perception with the hearing aids as compared to without hearing aids⁷. Calculations were performed with the aid of the Phonak Fitting Guideline computer program, used for hearing aids programming.

The following behavioral tests were also applied in order to assess auditory processing: dichotic digits test (DD)⁸ and speech in noise monotic test (SN)⁹.

The DD test was conducted to assess the binaural integration task. For analysis of the results, the number of errors on each ear - considered normal a percent accuracy above 90% for adults and youth - was computed¹⁰.

The SN test was applied to assess the auditory closure ability. The hit rate was calculated for each ear. A study reported in the literature that elderly individuals with hearing within normal limits presented percent accuracy of 64.8% and 72% respectively for first and second ears, and elderly individuals with hearing loss presented accuracy of 61.2% and 62.8%⁹.

After four weeks from the first assessment participants filled the Aphab questionnaire once again. After completing eight weeks, the same questionnaire and mentioned behavioral tests were reapplied.

The auditory training program carried out with the EG was adapted from procedures based on Musiek and Schochat¹¹. The program consisted of six weekly training sessions lasting 40 minutes each, plus 10-20 minutes of guidelines on the use of hearing aids and communication strategies. This was performed with the use of CDs containing tests to assess auditory processing², in a sound attenuating booth with headphones. The first three sessions occurred without the hearing aids and the other three sessions with the hearing aids.

The tasks implemented during the sessions were: training of figure/ground ability; training of auditory closure ability; training of temporal processing abilities; training of binaural integration and separation; and dichotic speech perception. The number of errors, accuracy and overall performance of individuals were computed for each task.

According to necessity reported by the individuals, adjustments were made in the hearing aids program aiming to provide improved audio quality in situations of daily life.

The following tests were used for the statistical analysis: Paired Student T-Test for the within-group analysis; ANOVA for between-groups comparisons; and Multiple Tukey test to analyze all assessments by comparing them two by two. The level of significance (p) of this study was set at 0.05 (5%) and 95% confidence.

Results

When comparing data of the DD and SN tests from both groups, no statistically significant difference between tests was found that for the first assessment - prior to implementing the program of auditory training. For the second assessment - after completion of the auditory training program - statistically significant differences between mean values were observed for both tests (Table 1).

The calculation of the benefit - obtained with data from the Aphab questionnaire - was defined as the difference in performance of individuals between the conditions without hearing aids (NHA) and the conditions with hearing aids (WHA), (NHA - WHA = Benefit).

Tables 2 and 3 display the values of benefit in the second and third assessments. The results showed statistically significant differences among the following subscales: EC, VR and EN in both assessments of both groups (EG and SG).

TABLE 1. Comparative percent values of DD and SN tests in the first and second assessments for both groups (EG and SG).

Tests	DD				SN			
	First Assessment		Second Assessment		First Assessment		Second Assessment	
	EG	SG	EG	SG	EG	SG	EG	SG
Mean	69.90%	61.50%	86.30%	70.70%	68.90%	66.80%	79.90%	68.90%
Median	75%	62.50%	90%	73.80%	72%	68%	82%	68%
Standard Deviation	22.90%	23.50%	14.40%	22.40%	13.30%	9%	8.60%	9.70%
Minimum	12.50%	17.50%	22.50%	12.50%	32%	48%	56%	46%
Maximum	100%	100%	100%	100%	92%	84%	96%	88%
N	42	42	42	42	42	42	42	42
CI	6.90%	7.10%	4.30%	6.80%	4%	2.70%	2.60%	2.90%
p-value	.101		<.001*		0.400		<.001*	

Note: DD – dichotic digits; SN – speech in noise; EG – experimental group; SG – Sham Group; CI – Confidence Interval; * - statistically significant p-values according to level of significance.

TABLE 2. Percent values of benefit obtained through the Aphab questionnaire on the second assessment for EG and SG.

Benefit	EC		RV		EM		AS	
	EG	SG	EG	SG	EG	SG	EG	SG
Second Assessment								
Mean (%)	58.19	35.62	65.62	31.48	50.90	18.43	-21.90	-15.67
Median	64	37	72	29	55	19	-13	-9
Standard Deviation	24.74	11.87	14.02	10.78	18.68	7.97	30.62	26.68
Minimum	7	14	37	14	-6	2	-94	-87
Maximum	93	56	82	54	74	37	43	16
n	21	21	21	21	21	21	21	21
CI	10.58	5.98	6.00	4.61	7.99	3.41	13.10	11.41
p-value	.001*		<.001*		<.001*		0.486	

Note: Aphab - Abbreviated Profile of Hearing Aid Benefit; EG – experimental group; SG – Sham group; EC – easiness of communication; RV - reverberation; EN – environmental noise; SA – sound aversion; CI – confidence interval; * - statistically significant p-values according to level of significance.

TABLE 3. Percent values of benefit obtained through the Aphab questionnaire on the third assessment for EG and SG.

Benefit	EC		RV		EM		AS	
	EG	SG	EG	SG	EG	SG	EG	SG
Third Assessment								
Mean (%)	70.57	45.57	73.19	36.90	63.24	26.33	-6.81	-5.90
Median	77	45	72	37	66	25	-2	-4
Standard Deviation	19.46	11.58	12.68	11.79	18.07	9.74	26.76	16.90
Minimum	23	22	51	14	17	10	-83	-44
Maximum	95	66	92	56	88	46	59	30
N	21	21	21	21	21	21	21	21
CI	8.32	4.95	5.42	5.04	7.73	4.71	11.44	7.23
p-value	<.001*		<.001*		<.001*		0.896	

Note: Aphab - Abbreviated Profile of Hearing Aid Benefit; EG – experimental group; SG – Sham group; EC – easiness of communication; RV - reverberation; EN – environmental noise; SA – sound aversion; CI – confidence interval; * - statistically significant p-values according to level of significance.

Discussion

Regarding the results obtained on the DD test - when analyzed only data of the first assessment (Table 1) - it was observed that both groups presented lower accuracy than those reported by Musiek¹⁰ for young adults (90%) and by Luz and Pereira¹² for elderly individuals with hearing within normal limits (first ear: 88.72% and second ear: 89.75%).

When analyzing the results obtained on the SN test on the first assessment (Table 1), it was found that both groups presented similar accuracy than that reported by Schochat and Pereira⁹ for elderly individuals with hearing loss (61.2% and 62.8%).

From the data of both tests, one can infer the presence of auditory processing disorder in the participants of the study. Such disorder is characterized by difficulties on: auditory discrimination, speech comprehension in noisy or reverberant environment, talking on the phone as well as auditory memory and behavioral deficits^{1, 13}; besides evidence of central auditory dysfunction⁹.

Statistically significant difference was observed on the between-groups comparison of the DD test - mean accuracy of 86.3% for EG and of 70.7% for GS. According to these results, the EG presented a mean accuracy score (86.3%) close to that reported in other studies^{10, 12}.

On the between-groups analysis for the SN test, the EG also showed statistically significant higher accuracy than the SG on the second assessment - 79.9% and 68.9% respectively. Therefore, were observed on the current study, higher mean accuracy scores than those reported by Schochat and Pereira⁹ for elderly individuals with hearing within normal limits (first ear: 64.8% and second ear: 72%) and for elderly individuals with hearing loss (first ear: 61.2% and second ear: 62.8) and similar to those found by Gil¹⁴ after auditory training in adults (77.7%).

The data obtained on the DD and SN tests may suggest that the training of auditory skills associated with the use of hearing aids improved the auditory processing abilities performance. Specifically, it was observed that the auditory training improved: the ability to group components of the acoustic signal in figure/ground and the ability to verbally identify such components⁸ as well as the speech recognition with competitive noise¹⁴⁻¹⁷. Such improvement may be related to the ability of the Central Auditory System to reorganize and alter its function in response to stimulation and amplification³.

Some authors have observed an increase on benefits with the use of hearing aids associated to certain type of auditory training in elderly and young adults¹⁴⁻¹⁸ as well as in children and young individuals with hearing within normal limits^{11, 19-20}.

The benefit defined by the difference in performance of the participants according to the Aphab questionnaire was analyzed by comparing

the first and the third assessments (Tables 2 and 3).

When comparing the two groups (between-groups analysis), there was statistically significant difference for the EC, RV and EN subscales for the second and third assessments, suggesting benefit in situations with communication easiness and in reverberant and noisy environments after the auditory training that occurred during the adaptation process. Moreover, the higher benefit of EG as compared to SG, especially after eight weeks of use of hearing aids, raised the hypothesis that the effect of acclimatization occurred near the eighth week of hearing aids use. Acclimatization may occur between six and 12 weeks of use of hearing aids²¹.

No statistically significant differences between the second and third assessments were observed for the SA subscale. It was observed a higher percentage of benefit for EG (second assessment: - 21.9%, and third assessment: -6.81) when compared to SG (second assessment: - 15.67%, and third assessment: - 5.90). The data suggest that the aversion to loud sounds is frequently observed on the process of hearing aid adaptation²². This is considered a difficult aspect to be treated as it may be associated with recruitment²³.

The data presented elucidate the initial hypothesis regarding the effectiveness of auditory training program associated with the use of binaural hearing aids. Results of EG showed an improvement in the auditory processing performance. In addition, one can observe an improvement in speech comprehension in noisy and reverberating environments¹⁴⁻¹⁷ as well as in the quality of life of the elderly individuals.

Conclusions

After analyzing the results it can be concluded that:

- . the auditory training program in a sound attenuating booth aided on the improvement of auditory processing abilities as statistically significant differences between EG and SG were observed for DD and SR tests in the second assessment (with hearing aids);
- . statistically significant differences between EG and SG regarding the benefit obtained - as measured by the Aphab questionnaire - were observed for the subscales EC, VR and EN in the second and third assessments (with hearing aids).

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