The Journal of International Advanced Otology

J Int Adv Otol 2023; 19(2): 116-120 • DOI: 10.5152/iao.2023.22787

Original Article

Age at Fitting Affected Unilateral Versus Bilateral Hearing Aids Choice in Asymmetric Hearing Loss

Andrea Frosolini, Pietro Cinquemani, Cosimo de Filippis, Andrea Lovato

Department of Neuroscience DNS, Audiology Unit at Treviso Hospital, University of Padova, Treviso, Italy

ORCID IDs of the authors: A.F. 0000-0003-1347-4013, P.C. 0000-0003-4284-1468, C.F. 0000-0002-2491-7783, A.L. 0000-0003-0369-1751.

Cite this article as: Frosolini A, Cinquemani P, Filippis Cd, Lovato A. Age at fitting affected unilateral versus bilateral hearing aids choice in asymmetric hearing loss. *J Int Adv Otol.* 2023;19(2):116-120.

BACKGROUND: Bilateral hearing aids are desirable to restore hearing in the most effective and natural way. The aim of the present study was to identify which type of hearing rehabilitation was preferred by our patients and which factors drove their choice.

METHODS: One hundred eight patients with moderate-to-severe asymmetrical hearing loss before and after a 1-month trial with bilateral hearing aids were considered.

RESULTS: As high as 58.3% of patients decided to continue with bilateral hearing aids (group BI), while 41.7% chose unilateral hearing aid (UNI group) in the best ear. Patients in the UNI group were significantly older than those in the BI group ($P=.04$); age > 77 years was an independent prognostic factor of unilateral hearing aid choice (odds ratio = 6.26; $P=.04$). Matrix test scored significantly worse with a single hearing aid than with 2 hearing aids in both groups (UNI $P=.03$; BI $P=.01$).

CONCLUSION: Patients with asymmetric hearing loss often prefer unilateral hearing aid, almost half in our experience. Nonetheless, bilateral hearing aids are desirable as unilateral hearing aid was associated with significantly poorer performance at a speech in noise hearing tests. Age at fitting could play a relevant role and is thus important in early diagnosis. Further studies are needed to confirm our results and investigate strategies to promote bilateral rehabilitation.

KEYWORDS: Hearing aids, hearing loss, audiology

INTRODUCTION

Hearing is part of people's lives and an adequate connection with the surrounding world depends, among other things, on the detection and discrimination within the auditory space.[1] Binaural hearing is of critical importance for a wide variety of species. In fact, the binaural cues represented by the interaural difference in time and loudness with which the auditory waves reach the 2 ears are crucial to assign a position in space to sounds.[2,3] This plays an important role in speech understanding in noise, with a consequent implication for incidental hearing and incidental learning for both adults and children.[4]

Hearing aids (HAs) are effective at improving listening ability, communication skills, and general health-related quality of life in subjects with hearing impairment.[5] With regard to asymmetrical hearing loss, bilateral HAs are desirable in order to restore hearing in the most effective and natural way. However, audiologists' clinical practice has often shown patients preferring unilateral HA despite the bilateral fitting recommendation.[6] This has been attributed to different causes: economic, aesthetical, and subjective discomfort related to the phenomenon of binaural interference.[7]

In this retrospective study, we evaluated a series of patients with asymmetrical hearing loss who underwent a 1-month trial with bilateral HAs. The main objectives of this study were to identify which type of hearing rehabilitation—binaural or monaural—was preferred by the patients and which factors drove this choice.

Corresponding author: Andrea Lovato, e-mail: andrea.lovato.3@hotmail.it

Received: May 2, 2021 • **Accepted:** October 4, 2022 • **Publication Date:** March 24, 2023
Available online at www.advancedotology.org

METHODS

Patients Selection and Management

The study was conducted in accordance with the principles of the Helsinki Declaration and was approved by the internal Ethical Committee (n. 02-2020AU). Data were examined in agreement with the Italian privacy and sensible data laws. All patients included in the study signed a detailed informed consent form. Patients with asymmetric hearing loss candidates for bilateral HAs were evaluated.

The inclusion criteria were the following: (i) age ≥ 18 at first evaluation; (ii) moderate-to-severe hearing loss, defined as a pure-tone average (PTA) at 500-1000-2000-4000 Hz superior to 41 dB and inferior to 95 dB for both ears;[8] (iii) asymmetric hearing loss, considered as an interaural difference in PTA of at least 10 dB;[9] (iv) HAs trial for 1 month. Patients diagnosed with psychiatric and/or neurological pathologies were excluded.

At the first visit (T0) a complete audiological evaluation was conducted. During the 1-month HA trial, patients were followed up with weekly HA fitting sessions. At the end of the trial month (T1), the patients underwent a second complete audiological evaluation including a Matrix test for both bilateral and unilateral HA conditions. After that, the patients independently chose to continue with bilateral HAs (BI group) or unilateral HA (UNI group), and the reasons for the choice were investigated through a closed answer questionnaire (Appendix 1).

Audiological Evaluation at T0 and T1

Medical history, including hearing loss etiology and duration, was acquired for all patients. Otoscopy was done to confirm the anatomical integrity of the external ear canal and tympanic membrane.

Pure-tone audiometry was performed in a silent cabin for both air and bone conduction. All frequencies from 250 Hz to 8000 Hz were tested as previously reported.[8] To eliminate the interaction of the contralateral ear caused by interaural attenuation, a narrow band noise was administered to the better ear while testing the worst ear.[10] Hearing loss was classified into mild hearing loss (PTA 21-40 dB); moderate hearing loss (PTA 41-70 dB HL); severe hearing loss (PTA 71-95 dB HL); and profound hearing loss (PTA greater than 95 dB) as previously reported.[11] Interaural difference in PTA (worst ear PTA – best ear PTA) was calculated for every patient. For the unaided word recognition score, a list of 25 disyllabic common Italian words was presented at 70 dB, as previously reported.[12] While testing the worst ear, narrow band noise was administered to the contralateral.

As a speech-in-noise test, the Italian version of the Matrix Test was performed in both unaided and aided conditions, in a soundproof cabin, with the speaker at azimuth position.[13] This test is designed to evaluate the patient's verbal understanding in difficult conditions, similar to those of daily listening in the presence of background noise. It is based on a matrix of simplified sentences, generated by creating seemingly random phrases from a table of 50 words. The Matrix test is defined as an adaptive test because it becomes "easier" or "more difficult" after each patient's response by modifying the presentation decibel of the voice message, while the competition noise remains constant at 65 dB. In this test, signal-to-noise ratio (SNR) varies at every presented sentence, and consequently, Matrix test cannot have a fixed SNR to be reported. The test tends to converge to the decibel value at which the patient will understand about 50% of the words presented, named as speech reception threshold, for which the reference normal values in the adult Italian population are -7.3 ± 0.8 dB.[13]

As a subjective evaluation method, the Speech, Spatial, and Qualities of Hearing Scale (SSQ) questionnaire Italian version 5.6 was used. The participant is asked to answer a total of 49 questions based on a 10-point Likert scale. The questionnaire is divided into 3 sections—speech perception, spatial perception, and sound quality perception—the total result ranges from 0 to 10 and is the average result of the 49 questions. It is a validated and diffuse instrument for evaluating hearing interventions of various kinds, particularly those that implicate binaural function.[14] In our study, the questionnaire was administered before and after application of the HAs.

Hearing Aids Fitting

The patients in the study were fitted with bilateral digital, behind-the-ear HAs from GN Resound (Denmark). The following models were used: Enya, Linx 3D, Linx 4, Resound One, and Resound Key. The speaker in the ear version was preferred in most cases over the speaker beyond the ear version. For the prosthetic fitting, the real ear measurement obtained by the Natus Aurical system (California, USA) was performed on all patients to assess the response of the ear to amplification.[15]

During HA fitting, to understand how the hearing amplification improved the hearing threshold, the pure-tone audiometry (250-500-1000-2000-4000-8000 Hz) and speech audiometry in the free field were performed, as previously reported.[12]

These batteries of tests were carried out at every fitting appointment: on the first day of application (T0), then after 7, 14, and 21 days and finally at the end of the trial test, after 1 month (T1).

Statistical Analysis

We used Fisher's exact test, the Mann–Whitney *U* test, the chi-square test, and Wilcoxon signed-rank test as appropriate.

For every significant association disclosed by the Fisher exact test, we calculated an odds ratio (OR). When necessary, continuous variables were dichotomized according to the median value as previously reported.[8] A multivariate logistic model was constructed, adding only the clinical parameters with a P value ≤ 0.1, as disclosed by Fisher's exact test at univariate analysis. The results were expressed as ORs, P values, and 95% confidence intervals (CIs). During the analysis, the model was checked for multicollinearity with a variance inflation factor test. A P-value $< .05$ was considered significant. The quality of the model was assessed with Pearson chi-squared test, a non-significant result ($P \geq .05$) meaning a good fit of the model to the data.

The Social Sciences version 17 statistical package (SPSS Inc., Chicago, Ill, USA) was used for all analyses.

RESULTS

After applying the inclusion and exclusion criteria, we included 108 patients with asymmetric hearing loss, 48 males and 60 females, with a mean age of 74.1 years, and a standard deviation (SD) of 15.1. The causes of hearing loss were presbycusis in 21 patients, occupational noise exposure in 21, otosclerosis in 12, chronic otitis media in 12, sudden hearing loss in 12, head injury in 6, Ménière disease in 6, and idiopathic in 18 patients.

After the 1-month trial test with bilateral HAs, 63 patients (58.3%) decided to continue with bilateral HAs (group BI), while 45 (41.7%) chose to keep an HA only in the best ear (UNI group). Patients in the UNI group reported the following reasons for their choice: "I did not feel any hearing improvement with two Has" in 27 cases, "Two HAs make me more confused" in 12 cases; and "Economic reasons" in 6 cases.

Table 1 shows the clinical and audiological characteristics of the patients in the 2 groups without HAs at the first evaluation (T0). We found no differences in the audiological characteristics and results of the SSQ questionnaire. Patients in the UNI group were significantly older than those in the BI group ($P = .04$ Mann–Whitney U-test).

Using Fisher's exact test, we performed a univariate analysis with dichotomized variables (Table 2), in order to discover an association with unilateral device choice. We found a significant association for age > 77 years ($P = .03$; OR = 8.25). Etiology was not associated with unilateral choice (presbycusis vs. other causes, $P = .89$; occupational noise exposure vs. other causes, $P = .49$; otosclerosis vs. other causes, $P = 1.00$; chronic otitis media vs. other causes, $P = .49$; sudden hearing loss vs. other causes, $P = .78$; head injury vs. other causes, $P = 1.00$; Ménière disease vs. other causes, $P = .98$; Fisher's exact test). Univariate analysis disclosed 3 characteristics with a P-value ≤ .1 at Fisher's exact test: age > 77 years and worse-ear PTA > 78.75 dB, and interaural difference in PTA > 26 dB. Using these 3 variables in the model, no multicollinearity was detected by the variance inflation factor test. Whereas worse-ear PTA (OR = 1.68; $P = .22$, 95% CI 0.64-3.18) and interaural difference in PTA (OR = 1.96; $P = .12$, 95% CI 0.98-4.43) were not associated with the final device choice, age > 77 years was an independent prognostic factor of unilateral HA choice in asymmetrical hearing loss patients (OR = 6.26; $P = .04$, 95% CI 1.31-15.90). The result of Pearson's chi-squared test ($P = .49$) showed a good fitting of the empirical model to real data.

Table 1. Clinical and Audiological Characteristics of the Patients Before the 1-Month Trial with Bilateral Hearing Aids

	BI Group	UNI Group	*P* *
Gender (male/female)	39/24	21/24	.17
Mean age (years)	70.4	79.2	**.04**
Mean hearing loss duration (years)	7.9	8.1	.91
Mean PTA (dB) best ear	53.2	51.6	.53
Mean PTA (dB) worst ear	77.8	82.8	.18
Mean interaural difference in PTA (dB)	25.9	31.3	.1
Mean unaided WRS best ear (%)	78.1	73.2	.43
Mean unaided WRS worst ear (%)	23.1	19.1	.22
Mean unaided SRT at Matrix test (dB)	11.5	11.1	.90
Mean SSQ (0-10 scale)	3.7	3.2	.22

BI, bilateral group; PTA, pure-tone average at 500-1000-2000-4000 Hz; SRT, speech reception threshold; SSQ, speech spatial questionnaire; UNI, unilateral group; WRS, word recognition score.
Significant values have been highlited in bold.
*Mann–Whitney *U* test, significant at $P < .05$.

Table 2. Univariate and Multivariate Analysis of Association Between Clinical and Audiological Characteristics (Dichotomized According to Median Value When Needed) and the Choice of Unilateral Hearing Aid in Asymmetrical Hearing Loss Patients

	Univariate[a]	Multivariate[b]
Gender	0.20	NA
Age > 77 years	**0.03**	**0.04**
Etiology (idiopathic vs. other causes)	0.43	NA
Hearing loss duration > 7 years	1.0	NA
PTA best ear > 52.5 dB	0.45	NA
PTA worst ear > 78.75 dB	0.1	0.22
Interaural difference in PTA > 26 dB	0.07	0.12
Unaided WRS best ear > 75%	0.55	NA
Unaided WRS worst ear > 30%	0.22	NA
Average SRT at Matrix test (dB) > 11.4 dB	1.0	NA
SSQ average > 3.2	0.34	NA

PTA, pure-tone average at 500-1000-2000-4000 Hz; SRT, speech reception threshold; SSQ, speech spatial questionnaire; WRS, word recognition score.
Significant values have been highlited in bold.
[a]Fisher's exact test, significant at $P < .05$.
[b]Only clinical parameters with $P < .1$ at univariate analysis were included in the multivariate logistic model.

At the end of the 1-month trial, the Matrix test with bilateral HAs showed no differences between the 2 groups ($P = 1.0$, Mann–Whitney U test). As shown in Table 3, Matrix test with a single HA showed poorer results in both groups (UNI group, $P = .03$; BI group $P = .01$; Mann–Whitney U test).

The results of the SSQ questionnaire were significantly lower in the UNI group at the end of the 1-month trial, with a mean total SSQ of 8.4 in the BI group and 7.1 in the UNI group ($P = .04$, Mann–Whitney U test).

DISCUSSION

For people, effective spatial orientation including the ability to discriminate the direction, distance, and movement of sounds is critical to understanding speech and other structured sound streams.[3] Binaural hearing offers significant advantages in challenging and dynamic situations; these contexts are considered significant in maintaining social competence and emotional well-being. In 2004, Noble and Gatehouse[6] evaluated patients with symmetrical (103 subjects) and asymmetric (50 subjects) bilateral hearing loss and compared the disabilities reported by these 2 groups with the SSQ questionnaire. As expected, the spatial hearing was severely impaired in the asymmetric group. In addition, patients with asymmetric hearing

Table 3. Comparison of Speech Recognition Threshold Resulted at Matrix Test at the End of the 1-Month Trial with Hearing Aids

	BI Group	UNI Group	*P*[*]
Bilateral HA	1.0 dB (SD 0.4 dB)	1.3 dB (SD 0.9 dB)	1.0
Unilateral HA	3.9 dB (SD 0.9 dB)	3.2 (SD 1.7 dB)	.45
P[*]	**.01**	**.03**	

BI, bilateral group; HA, hearing aids; SD, standard deviation; UNI, unilateral group.
Significant values have been highlited in bold.
[*]Mann–Whitney *U* test, significant at $P < .05$.

loss reported greater disability in other SSQ scales when compared to patients with symmetrical hearing loss. This confirmed that asymmetric hearing loss is associated with a significant and generalized hearing impairment, not limited only to the localization of sounds; therefore, optimal bilateral HAs fitting in these patients should be mandatory. In 2006, the same authors evaluated 118 patients with 6 months of experience with unilateral amplification and 42 patients with 6 months of experience with bilateral amplification: the benefit of 2 hearing devices was evident when listening to speech in demanding contexts.[6]

Clinical practice often confronts us with results that can be considered contradictory with respect to scientific evidence: in this sense, it is not uncommon to evaluate patients with hearing loss who refuse bilateral HAs and choose to keep only one HA. The objective of this retrospective study was to investigate whether there were any clinical or audiological differences associated with this type of choice. We considered 108 patients with moderate-to-severe asymmetric hearing loss who used 2 HAs for 1 month. At the end of the trial, 63 patients chose to continue using 2 HAs (BI group) while 45 subjects chose to use only 1 HA in the best ear (UNI group). Analyzing the reasons for refusal of bilateral HAs in the UNI group, most of the patients (39 cases) complained about a lack of benefit, or even a worse hearing experience using 2 devices, while the motivation was economic in only 6 subjects. Comparing clinical and audiological characteristics between the 2 groups, we found no differences in gender distribution, hearing loss duration, tone audiometry, or Matrix test performed without HAs. Our main finding was that UNI group patients were significantly older than BI group subjects (79.2 vs. 70.4 years); at both univariate and multivariate analysis, age greater than 77 years was an independent prognostic factor in the choice of unilateral HA in patients with asymmetric hearing loss (OR = 6.26; $P = .04$). Nevertheless, in the UNI group, the Matrix test showed a significant improvement with bilateral HAs compared to the unilateral HA fitting (1.3 dB vs. 3.2 dB, $P = .03$). Therefore, according to our results, the aged patients that chose unilateral HA seemed to have difficulty perceiving the improvement given from bilateral HAs; the reasons why and the possible interventions should be investigated in future studies (Table 3).

An elderly patient may experience difficulties in using HAs. Some commonly reported reasons concern the manual difficulty in using the device, aesthetic problems, or economic difficulties. A social–economic role was recently found in a study including 191 elderly people: patients who continued to work also used HAs.[16] In our patients, financial issues were only reported by 6 patients, while the majority reported greater hearing difficulty with 2 devices. Other authors have reported that elderly patients with bilateral hearing loss sometimes choose unilateral HAs because the use of 2 HAs causes greater disturbance.[7] Elderly patients can have central auditory processing disorders due to the aging process of the peripheral and central auditory pathways. This process could result in decreased auditory information processing, leading to difficulties in verbal and non-verbal information processing.[3] A recent study evaluated 30 elderly patients with symmetrical bilateral hearing loss having bilateral HAs for over 6 months, but with effective use of only 1 device. These patients were evaluated with a dichotic hearing test and all the participants had abnormal results. The authors concluded that, in elderly patients who chose unilateral HAs, the ear chosen was the one that was dominant.[7] In our study, patients chose unilateral HAs in the best ear, which we could reasonably assume was the dominant one in asymmetrical hearing loss. These patients had significantly higher average age, and an associated deficit in the processing of auditory information at a central level can be hypothesized and should be further investigated.

Several studies identified hearing loss as an independent risk factor for dementia, estimated to account for 9% of cases.[17] Preliminary reports are showing the effectiveness of HA fitting in the prevention of cognitive decline in the aging population.[18] As reported, in our group of aging patients, a unilateral HA was associated with significantly poorer performance at the Matrix test (Table 3). It is therefore essential in our opinion to stimulate the adaptation of these patients with asymmetrical hearing loss to bilateral HAs. One way could be to perform tests longer than a month: in this way, the patient would have more time to perceive the improvement offered by 2 prostheses. In this sense, a trial of at least 2 months could increase the perception of hearing and health-related benefits in these patients.

The strengths of the present study are as follows: (i) adequate consecutive sample of patients with asymmetrical hearing loss referred to our center selected following well-defined reported inclusion/exclusion criteria; (ii) the gold-standard intervention of HA fitting in a referral audiology center; and (iii) the outcome evaluation with the application of a complete battery of audiological test, including audiometric test and validated questionnaire. The limitations of the present research are mainly due to the retrospective design: this type of study is not allowed to control for confounding factors that were not included in the routine evaluation and did not permit a preliminary power and sample size estimation. Future studies will aim to overcome these limitations possibly with RCT studies with longer follow-up.

CONCLUSION

The results of our retrospective study showed that almost half of the patients with moderate-to-severe asymmetrical hearing loss chose unilateral HA after a trial period with bilateral HAs. The higher age at fitting was an independent prognostic factor of this choice. Further studies are needed to confirm our results and investigate strategies to promote bilateral rehabilitation in these patients.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Treviso Hospital (Approval No: 1196/CE).

Informed Consent: Written informed consent was obtained from the participants who participated in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – C.d.F., A.L.; Design – A.L.; Supervision – C.d.F., A.L.; Materials – C.d.F., A.L.; Data Collection and/or Processing – P.C., A.L.; Analysis and/or Interpretation – A.F., A.L.; Literature Review – A.F., A.L.; Writing – A.F., A.L.; Critical Review – A.F., A.L.

Acknowledgments: The authors thank Vanessa Arato for correcting the English version of this paper.

Declaration of Interests: The authors declare that they have no competing interest.

Funding: The authors declare that this study had received no financial support.

REFERENCES

1. Wie OB, Pripp AH, Tvete O. Unilateral deafness in adults: effects on communication and social interaction. *Ann Otol Rhinol Laryngol*. 2010; 119(11):772-781.
2. Firszt JB, Reeder RM, Dwyer NY, Burton H, Holden LK. Localization training results in individuals with unilateral severe to profound hearing loss. *Hear Res*. 2015;319:48-55. [CrossRef]
3. Keating P, King AJ. Developmental plasticity of spatial hearing following asymmetric hearing loss: context-dependent cue integration and its clinical implications. *Front Syst Neurosci*. 2013;7:123. [CrossRef]
4. Krishnan LA, Van Hyfte S. Management of unilateral hearing loss. *Int J Pediatr Otorhinolaryngol*. 2016;88:63-73. [CrossRef]
5. Ferguson MA, Kitterick PT, Chong LY, Edmondson-Jones M, Barker F, Hoare DJ. Hearing aids for mild to moderate hearing loss in adults. *Cochrane Database Syst Rev*. 2017;2017(9):CD012023. [CrossRef]
6. Noble W, Gatehouse S. Interaural asymmetry of hearing loss, Speech, Spatial and Qualities of Hearing Scale (SSQ) disabilities, and handicap. *Int J Audiol*. 2004;43(2):100-114. [CrossRef]
7. Ribas A, Mafra N, Marques J, Mottecy C, Silvestre R, Kozlowski L. Dichotic hearing in elderly hearing aid users who choose to use a single-ear device. *Int Arch Otorhinolaryngol*. 2014;18(4):347-351. [CrossRef]
8. Lovato A, Frosolini A, Marioni G, de Filippis C. Higher incidence of Ménière's disease during COVID-19 pandemic: a preliminary report. *Acta Otolaryngol*. 2021;141(10):921-924. [CrossRef]
9. Tolisano AM, Burgos RM, Lustik MB, Mitchell LA, Littlefield PD. Asymmetric hearing loss prompting MRI referral in a military population: redefining audiometric criteria. *Otolaryngol.--Head Neck Surg*. 2018;158(4): 695-701. [CrossRef]
10. Farrell NF, Banakis Hartl RM, Benichoux V, Brown AD, Cass SP, Tollin DJ. Intracochlear measurements of interaural time and level differences conveyed by bilateral bone conduction systems. *Otol Neurotol*. 2017; 38(10):1476-1483. [CrossRef]
11. Lovato A, Tormene D, Staffieri C, Breda S, Staffieri A, Marioni G. Sudden hearing loss followed by deep vein thrombosis and pulmonary embolism in a patient with factor V Leiden mutation. *Int J Audiol*. 2014;53(9):625-628. [CrossRef]
12. Lovato A, Marioni G, Gamberini L, Bonora C, Genovese E, de Filippis C. OTOPLAN in cochlear implantation for far-advanced otosclerosis. *Otol Neurotol*. 2020;41(8):e1024-e1028. [CrossRef]
13. Puglisi GE, Warzybok A, Hochmuth S, et al. An Italian matrix sentence test for the evaluation of speech intelligibility in noise. *Int J Audiol*. 2015;54(suppl 2):44-50. [CrossRef]
14. Gatehouse S, Noble W. The Speech, Spatial and Qualities of Hearing Scale (SSQ). *Int J Audiol*. 2004;43(2):85-99. [CrossRef]
15. Denys S, Latzel M, Francart T, Wouters J. A preliminary investigation into hearing aid fitting based on automated real-ear measurements integrated in the fitting software: test-retest reliability, matching accuracy and perceptual outcomes. *Int J Audiol*. 2019;58(3):132-140. [CrossRef]
16. Bulğurcu S, Uçak I, Yönem A, Erkul E, Çekin E. Hearing aid problems in elderly populations. *Ear Nose Throat J*. 2020;99(5):323-326. [CrossRef]
17. Griffiths TD, Lad M, Kumar S, et al. How can hearing loss cause dementia? *Neuron*. 2020;108(3):401-412. [CrossRef]
18. Maharani A, Dawes P, Nazroo J, Tampubolon G, Pendleton N. Longitudinal relationship between hearing aid use and cognitive function in older Americans. *J Am Geriatr Soc*. 2018;66(6):1130-1136. [CrossRef]

Appendix 1. Questionnaire Given to the Patients After the 1-Month Trial Period

Please, write an x in correspondence to the statement that best describes the reason why you choose unilateral hearing aid over bilateral hearing aid (HA).
1. I did not feel any hearing improvement with 2 HAs
2. Two HAs make me more confused
3. Aesthetic reasons
4. Economic reasons
5. Other reasons (specify) ……………………………………………………………………………………………………… …… ……