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SUITABILITY OF HEARING AIDS USED BY STUDENTS OF SEKOLAH RENDAH PENDIDIKAN KHAS JALAN PEEL, KUALA LUMPUR

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ABSTRAK

Satu kajian untuk menilai kesesuaian pemakaian alat bantu pendengaran (ABD) di kalangan 42 orang pelajar Sekolah Rendah Pendidikan Khas Jalan Peel, Kuala Lumpur telah dijalankan. Kesesuaian pemakaian alat bantu pendengaran telah diukur dengan membandingkan ambang pendengaran berbantu yang diukur (MAT) dan ambang pendengaran berbantu sasaran (RAT), dikira menggunakan formula priskriptif NAL-RP. Keputusan menunjukkan bahawa ABD yang dipakai oleh kesemua subjek yang diuji adalah tidak bersesuaian dengan tahap pendengaran mereka, di mana 80% daripada ABD tersebut tidak memberi cukup amplifikasi manakala 20% lagi memberikan amplifikasi yang berlebihan. Ujian-t berpasangan menunjukkan terdapat perbezaan yang signifikan ($p<0.001$) pada semua frekuensi yang diuji. Hasil kajian ini menunjukkan tingginya insiden pemakaian ABD yang tidak sesuai di kalangan subjek yang diuji.

Kata kunci: Pemakaian alat bantu pendengaran, kanak-kanak bermasalah pendengaran.

ABSTRACT

A study was carried out to evaluate the hearing aid fitting among 42 students of Sekolah Rendah Pendidikan Khas Jalan Peel, Kuala Lumpur. The suitability of the fitting was measured by comparing the measured aided thresholds (MAT) and the required aided thresholds (RAT), calculated using the NAL-RP prescriptive formula. Results showed that in all subjects tested, the hearing aids used were not appropriate for their hearing losses in which, 80% of the hearing aids provided under-amplification while over-amplification was found in the remaining 20%. Paired t-test indicated that the differences between the MAT and the RAT were very significant ($p<0.01$) at all test frequencies. The result of this study revealed a high incidence (100%) of inappropriate hearing aid fitting amongst the tested subjects.

Keywords
Hearing aid fitting, hearing-impaired children

INTRODUCTION

It is generally acknowledged that the provision of effective amplification is an important component in the (re)habilitation of hearing-impaired children. Therefore, the task of fitting and evaluating the benefits of hearing aid for a child is not to be taken lightly.

In Malaysia, due to limited number of audiologists, many of the hearing impaired individuals have their hearing aid fitted by the hearing aid dealers. In these cases the appropriateness of the hearing aid fitting is often questionable. The main purpose of this study is therefore to look at the suitability of hearing aids used by a group of students from a deaf school in Kuala Lumpur. It is hoped that the results of this study will provide useful information towards improving the audiology services provided to the hearing impaired children.

MATERIALS AND METHODS

Subjects

The study group consisted of 42 students of Sekolah Rendah Pendidikan Khas

(SRPK) Jalan Peel, Kuala Lumpur who were referred by the school to our clinic for hearing assessment. They were 21 males and 21 females with age ranging from 5 to 14 years old. There were 2 cases with bilateral atresia of ear canal and both of them were using bone-conduction hearing aids (BCHA).

Procedure

Prior to the hearing tests, listening check was carried out with a stetoclip on each hearing aid to ensure that the hearing aid was well functioned.

For each subject, unaided hearing threshold levels (HTL) were measured in both ears separately using Madsen Orbiter 922 audiometer connected to TDH-39 headphones. The subjects' aided thresholds were measured in free-field condition using warble tones stimuli which were delivered through a loudspeaker positioned at 0° azimuth, at a distance of 1 meter from the child. Subject wore his/her hearing aid with volume set at his/her normally used volume setting. All tests were carried out in sound-treated audiology booths.

Based on the unaided HTLs of the individual subject, the RAT values were calculated using the National Acoustic Laboratories revised procedure (NAL-RP) formula[1]. The difference between the RAT and the MAT at each test frequency (250, 500, 1000, 2000 and 4000 Hz) were calculated. The mean difference between the two variables and the standard deviations were determined using descriptive statistics from the Minitab statistical software.

RESULTS

Hearing aids function

Stetoclip checking of the 64 devices showed that majority of the hearing aids (84.4%) were functioning well. However, we noted some problems in few hearing aids. There were 6 (9.4%) dysfunctioning aids that needed either to be repaired or to be serviced. Two hearing aids (3.1%) had flat batteries while another two hearing aids (3.1 %) were coupled to loose earmoulds that cause feedback problem.

Unaided hearing threshold measurements

Although 42 subjects (84 ears) participated in this study, only 36 of them were included in this study. The six excluded were 2 subjects who were aided with bone conduction hearing aids. They were excluded from the study as the procedure for evaluating bone conduction hearing aids is not similar to air conduction hearing aids. Another four were excluded because they had impacted wax (2) and did not give reliable response on pure tone audiometry (4). Table 1 showed the mean HTLs, standard deviations and ranges of HTLs for the remaining 72 unaided ears. In calculating the mean HTLs, the Left and Right HTLs were totalled and averaged under different test frequencies. Majority of the subjects were having severe and profound sensorineural hearing impairment bilaterally.

Aided threshold measurement

Twenty six subjects had binaural amplifications (52 aided ears) and 14 subjects were amplified monaurally, despite their severe losses in both ears. This has resulted in 66 aided ears. However, aided thresholds were only obtainable in 46 ears (69.7 %) while for the remaining 20 aided ears, aided thresholds were not measured due to several reasons.

Suitability of the hearing

The MAT values were subtracted from the RAT values at 250, 500, 1000, 2000 and 4000Hz to determine the suitability of the hearing aid fit. Negative values indicate that MAT are <u>worse</u> than the RAT which means that, the measured aided thresholds are not reaching the target. On the other hand, positive values show that the MAT are <u>over</u> the target. The MAT at any frequency is considered as satisfactory if it differs from the RAT by ± 3 dB. Figures 1 to 5 show the RAT-MAT difference at different test frequencies for the 46 hearing aids tested.

As shown in Figures 1 to 5, most of the hearing aids tested had MAT which was more than 3 dB below the RAT across the frequencies, suggesting that the hearing aids were not giving adequate gain at these frequencies. At 4000 Hz the MAT consistently fail to reach the RAT for all the tested aids. Positive difference values, which indicate that the gain was over the target were observed at 250, 500, 1000 and 2000 Hz in few hearing aids. The numbers were less, however, as the frequency increased.

Table 1 : Mean hearing threshold levels (HTLs), standard deviations (SD) and range of HTLs for 72 unaided ears (N = 72)

	Frequency (Hz)				
HTL (dB)	250	500	1000	2000	4000
Mean	84.79	95.90	105.63	105.21	103.4
SD	16.37	12.74	12.22	16.48	20.42
Range	20-110	65-125	75-125	60-125	55-125

HTL = hearing threshold level; SD = standard deviation

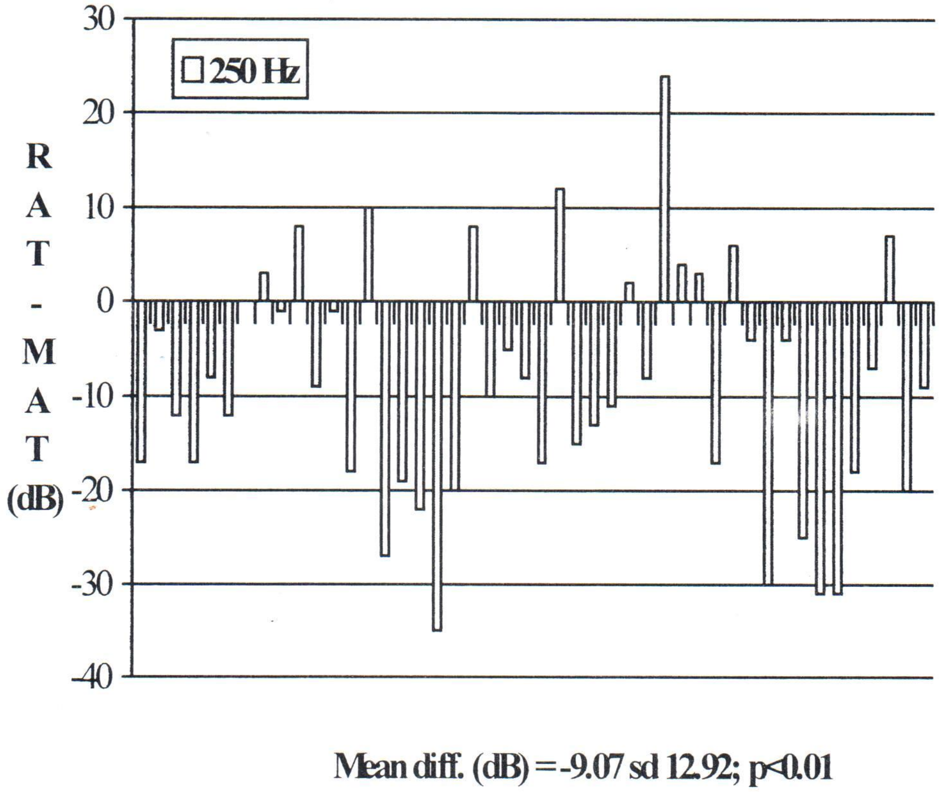
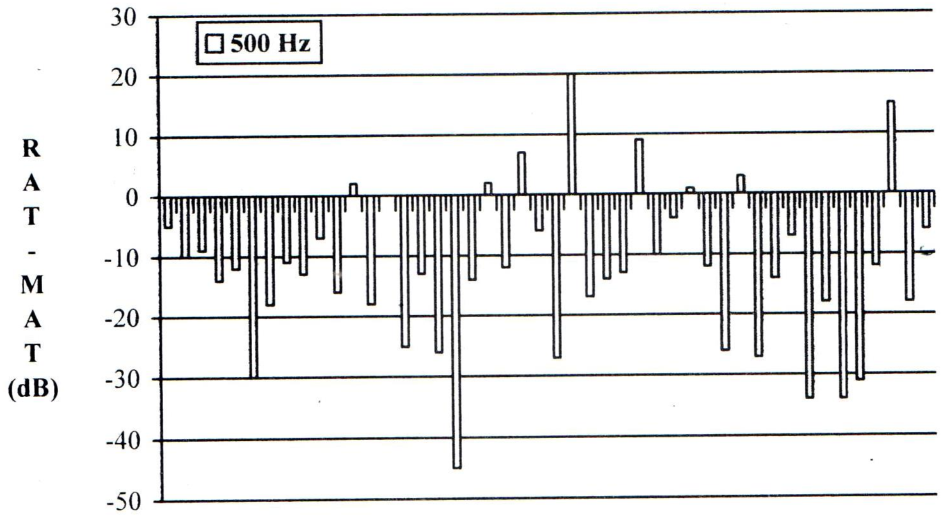
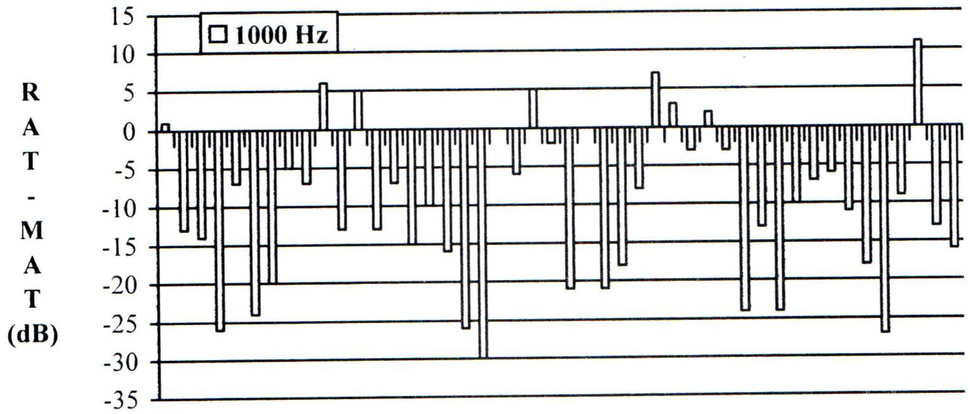


Figure 1 : The difference between the RAT and MAT (dB) at frequency 250 Hz



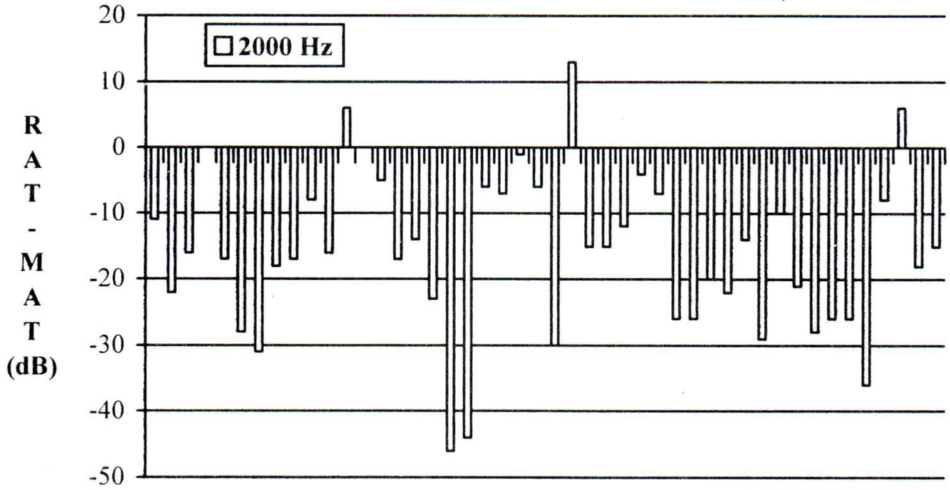
Mean diff (dB) = -12.37 sd 13.07; p<0.01

Figure 2 : The difference between the RAT and MAT (dB) at frequency 500 Hz



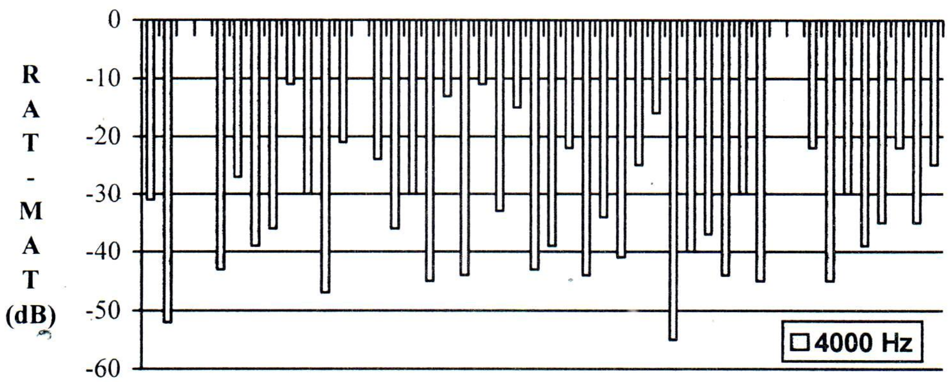
Mean diff. (dB) = -10.13 sd 10.27; p < 0.01

Figure 3 : The difference between the RAT and MAT (dB) at frequency 1000 Hz



Mean diff. (dB) = -16.73 sd 12.19; p< 0.01

Figure 4 : The difference between the RAT and MAT (dB) at frequency 2000 Hz



Mean diff. (dB) = -33.07 sd 11.26; p<0.01

Figure 5 : The difference between the RAT and MAT (dB) at frequency 4000 Hz

Table 2 : Mean RAT - MAT difference (dB) as a function of test frequencies

Frequency (Hz)	N	Mean difference (dB)	Std. deviation (SD)
250	46	*-9.07	12.92
500	46	*-12.37	13.07
1000	46	*-10.13	10.27
2000	44	*-16.73	12.19
4000	41	*-33.07	11.26

- $p < 0.01$

Table 2 shows the mean differences between the RAT and the MAT at different test frequencies. Paired t-test shows that the mean differences between the RAT and MAT were significant at all test frequencies ($p < 0.01$). These differences were considered significant as they were more than 3 dB at all test frequencies with the greatest difference found at 4000 Hz (-33.7 dB) and standard deviations (SD) ranged from 10.27 - 12.92 dB.

By defining **under amplification** as the (MAT) less than the required values (RAT) by 3 dB or more, in **at least 3** test frequencies ranging from 250 to 2000 Hz, 37 hearing aids (80.4%) were found to be under-amplifying. The 4000 Hz test frequency is not included as this is the most difficult frequency to amplify to the target because of the nature of the frequency response of the hearing aids in which it usually rolls off after the 3000 Hz.

Over amplification is defined as the MAT is more than 3 dB gain higher than the RAT in **at least one** of the test frequencies. Using this definition, it was found that the remaining 9 hearing aids were over-amplifying. These findings shows that 100% of the subjects in this study were using hearing aids that were not suitable for their hearing losses, thus, gaining minimum or no benefits from its use.

DISCUSSION AND CONCLUSION

In this study, 14 subjects (35%) were found to be fitted monaurally despite the fact that they have severe losses in both ears and thus, should be fitted binaurally to optimise the hearing aid fitting. Advantages of binaural amplification include better ability to localise sound sources and extract speech signals in noisy environment. Binaural fitting is also known to provide the wearer with summation effect in which they will be able to hear more natural sound quality, and able to set the volume wheel at lower volume setting[3]. There are some possible reasons as to why these children were not using 2 hearing aids. Firstly, it could possibly due to the cost of hearing aid which is quite expensive and unaffordable by parents, and secondly it could be due to improper advice from the relevant professionals.

Listening check through stetoclip revealed that majority of the subjects in this study wore good functioning aids (84.4%). However, 15.6% of them were found to use dysfunctioning aids, hearing aids with no/flat battery or wearing their hearing aids with loose earmould which cause feedback problem. These results revealed that some of the students were wearing hearing aids which were not performing at their best to give optimum benefit. It is likely that these children were wearing the aids just for the sake of wearing them, and the aids were not giving them of much help. These problems could be prevented or minimised if teachers or parents check the hearing aids daily.

The results of this study indicate that all of the subjects were using hearing aids which were not suitable for their severity of losses. The data presented showed that most of the hearing aids were giving insufficient amplification. Hence, the most basic purpose of wearing a hearing aid which is to amplify speech to a sufficient level to permit good understanding of speech by a hearing-impaired listener was not achieved. This is depressing as optimum fitting is vitally important for the success of (re)habilitation of hearing impaired children.

Optimisation of the hearing aid fitting can be done by several ways. First and foremost, the child must have good, sealed earmould to prevent acoustic feedback, and to ensure efficient delivery of sound into the auditory system. Secondly, the hearing aid needs to be well-functioned and performing according to the manufacturer's specifications. Ensuring these factors, the fitting can be optimised by resetting the aid, if possible, to achieve the needed gain or by changing the currently used hearing aid to the more powerful one if it is not giving enough power. The earmould can also be modified acoustically to boost up the performance of the fitting.

The results also revealed that 20% (n = 9) of the aids were giving more amplification than what was required, in at least 1 of the test frequencies. This was obvious at 250 Hz (Figure 3) in which nearly 30% of the hearing aids tested showed positive difference values between the RAT and the MAT. Some of the aids were also found to be over-amplifying at 500, 1000 and 2000 Hz test frequencies even though the numbers were smaller. It is obvious from these findings that there is still lack of awareness and knowledge among parents and the public about deafness issues in general, and the importance of having a good hearing aid fitting, care and usage. We need to emphasise here that it is not just a matter of wearing hearing aids that will help a child or an individual with a hearing loss but it is effective amplification that is important and vital in ensuring the success of their habilitation and/or educational programmes.

We conclude from this study that hearing aids worn by all the subjects of this study were not properly fitted, hence, not giving the expected benefits to the users. To overcome this, we strongly suggest that hearing aid selection, fitting and evaluation and the overall management of hearing-impaired people especially in children, must be done by qualified hearing health-care professionals.

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