"Can You Hear Me?"
A Longitudinal Study of Hearing Aid Monitoring in the Classroom

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Research articles cite the alarming statistic that, without a daily hearing aid check, 50% of hearing aids worn by school children are malfunctioning on any given day. Analysis of hearing aid monitoring data kept over a seven-year period at one elementary school supports the value of daily monitoring, finding only 5.5% of hearing aids malfunctioning when a child entered his or her classroom in the morning. This malfunction rate was reduced to less than 1% by the time class instruction started when simple troubleshooting procedures were implemented (e.g., readjusting settings or replacing a weak or dead battery). This study suggests that a comprehensive hearing aid monitoring program can effectively eliminate the problems reported in the literature. Recommendations for hearing monitoring are presented.

Introduction

Technological advances in hearing aids since 1960 have been phenomenal. yet the corresponding area of habilitation has not shown a similar pattern of growth. In 1966, Gaeth and Lounsbury sounded a clarion call. Their study of 134 elementary school children who wore hearing aids found that 45% of these aids were malfunctioning when they came to the clinic. After assessing the amount of gain provided by the aids, they concluded, "By a very lenient definition, no more than 50% of the children were getting any benefit at all from their hearing aids"(p. 287).

This sparked an interest in the amplification worn by children in the classroom. In an investigation of hearing aids worn by children in a residential school, Porter (1973) found a similar calamity, i.e., 51% were malfunctioning. When electroacoustic evaluation of hearing aids began, results remained dismal. Zink (1972) found 58% to be unacceptable; Coleman (1975) discovered 50% exceeded recommendations for SSPL, frequency response, and harmonic distortion; Robinson and Sterling (1980) classified 40% of the aids in their study as malfunctioning. A study by Lipscomb, Von Almen and Blair (1992) found that, for students with hearing loss in an inner city, the incidence of malfunctioning hearing aids was about 45% before any intervention.

The only study prior to 1983 that found fewer hearing aid problems was that of Kemker, McConnell, Logan, and Green (1979). Initially, 28% of their aids were discovered to be malfunctioning, but, after daily monitoring of the aids was instituted, the number of aids with problems dropped to 14%. Potts and Greenwood (1983) noted a similar occurrence. During daily monitoring 25% of the aids were judged as unsatisfactory. They stated that improved inspection procedures and additional training helped lower the incidence to 12% one year later. Lipscomb et al. (1992) found that when hearing aid monitoring and repair strategies were tried, the number of students wearing malfunctioning hearing aids dropped from 45% to 12%.

Two more recent studies (Elfenbein, 1994; Elfenbein, Bentler, Davis, & Niebuhr, 1988) found 22 and 33% of the aids to be malfunctioning respectively. An interesting note in the first study was that 10 of the children, while attending a six-week summer program, developed hearing aid problems that were so significant that 67% of their aids had to be sent for repair.

With so many children sitting in the classroom wearing malfunctioning aids, is it any wonder they are suffering educationally? Smedley and Plapinger (1988) investigated the effects of these nonfunctioning aids and found that they did not simply fail to amplify, they actually created an insertion loss that "may be as great as 40 dB for an individual child." This, added to the hearing loss already present, significantly impacts their ability to learn. Of all the studies cited, only Kemker et al. (1979) looked at hearing aid problems long term.

Given the magnitude of the problem, as reported in the literature over a long period of time, it is surprising that nothing has been published recently describing a program of continued monitoring and repair of hearing aids and how this process affects the use of functioning hearing aids. The purpose of the current study was to analyze data collected over seven years in which hearing aids were monitored on a daily basis at one elementary school.

Subjects

For the first five years (1992-1997), hearing aids of 3-6 year old children enrolled in a program for children with hearing loss in south Louisiana were monitored. The classes were self-contained and consisted of a class of three year old children and a class of four and five year olds. For the last two years, monitoring data were maintained on children 3-13 years old. In addition to the preschool classes already described, the older students

were in inclusive/ inclusion type classes, kindergarten through sixth grade, with one self-contained class of students having multiple disabilities. All students hearing losses were sensorineural except three, who had hearing loss due to bilateral atresia. Two of these students wore body style aids coupled to a bone oscillator fitted on a headband, and the third wore a behind-the-ear (BTE) aid coupled to the headband. The remaining students all wore BTE type hearing aids.

Procedure

A teacher assistant who had been trained in this procedure by a school audiologist checked the hearing aids of each child every morning upon arrival in the classroom. This check began with questions such as, "Is your hearing aid working? Is your hearing aid turned on?" The aids were then examined visually for cracked cases, moisture, earmolds clogged with wax, broken battery doors, damaged cords, or cracked tubing.

Any problems found were pointed out to the child. The third step in the process involved listening to the aid with a stethoscope for distortion, noise, and vocalization of the Ling six sounds. The battery was then tested using a battery tester and discarded if the voltage was less than 1.0 volts. The student was expected to assist in this portion of the daily check. Results were then recorded on a hearing aid tracking chart. These tracking charts provided the data for this study.

Results

Over the seven-year period 158 hearing aids were monitored. One hundred thirty-six were worn by preschoolers, 17 by elementary age children, and 5 by junior high students. Table 1 shows the percentage of hearing aids found to have problems.

No particular month across these years had a significantly larger amount of problems than any other month. However, one year (year 2) showed a significantly larger amount of problems compared to the other years. This may have been due to the fact that year was only 7 hearing aids, the fewest of any year. The mean percentage of malfunctioning hearing aids for the total seven years was 5.5% (range 3.0-10.9%).

The type of malfunctions varied slightly from year to year, but the largest number of problems were due to weak or dead batteries and wearing the aid on the "wrong setting". "Wrong setting" was marked if the on/off switch was found to be in either the "O" (off) or "T" (telecoil) position, or the volume wheel had been rotated 25% or more (up or down) from the prescribed setting. Table 2 is a summary of the types of malfunctions found. "Weak or dead battery" and "wrong setting" accounted for 76% of the malfunctions, while worn or cracked tubing, damaged cords, and feedback together represented only one percent of the total.

Discussion

Research over the last four decades pointed out an abysmal hearing aid situation among children who were deaf and hard of hearing. Almost 50% of hearing aids were found to be malfunctioning on any given day. This study found a much better level of hearing aid function when daily hearing aid monitoring and active hearing aid reinforcement was used. Through this program, an average of only 5.5% of hearing aids was malfunctioning on any given day. This finding suggests if hearing aids are properly monitored and repaired, the potential for wearing operational hearing aids is greatly enhanced. However, these data do not tell us if the improvement is in this district only, or if these results are typical of other programs where monitoring takes place. It would be helpful to have other professionals working with hearing aids in the schools report their results.

Analysis of the actual problems found several differences from previous studies. Periodic cleaning of earmolds by both parents and the school audiologist may have resulted in fewer number of earmolds reported as clogged with wax. Also, very few children today wear body type aids, so broken or damaged cords made up a proportionally smaller number of malfunctions than in the 1960's and 1970's. Finally, due to the location of this elementary school along the coastal South, where humidity rarely drops below 85%, more problems with moisture would have been expected. That the number was so small may have been due to the fact that the aids were checked upon arrival at school, rather than after a recess period. Of the malfunctions discovered, all but four (static or distortion, dead, internal noise, and broken battery door) would have been remedied at the time of discovery. Thus, if the remaining malfunctions (dead battery, wrong setting, etc.) were fixed before class began, then the 5.5% which were malfunctioning could have been reduced to less than 1% by the time classroom instruction started, considerably better than the almost 50% noted by previous researchers.

The fact that hearing aid problems exist in any great number today is unacceptable. One of the problems most often cited is disagreement about who is responsible for monitoring hearing aids. Wilson-Vlotman and Blair's (1986) survey of audiologists employed in schools indicated that 58% believed it was the responsibility of teachers of the deaf to monitor hearing aids daily, followed by audiologists (10%), parents (6%), and speech-language pathologists (4%). Elfenbein et al. (1988) found that teachers of the deaf were actually involved 78% of the time, audiologists 30%, and speech-language pathologists 3% of the time. Parents were not included in that study. Yet, hearing aid monitoring is most effective if it's done at home, when the aids are placed on the child's ears. As Elfenbein (1994) so aptly points out, "This is not an Olympic event in which only the best get medals; each parent must succeed" (p. 69). However, even if parents are actively involved in the monitoring and repair of their child's hearing aids, there is no guarantee that the battery will still be working by the time the child gets to school.

The second problem cited for not monitoring hearing aids is that too many people are simply unaware of its importance. In 1988, Elfenbein et al. found that teachers of children with hearing loss felt that hearing aid problems occurred rarely (62%) or only occasionally (31%). In addition, many regular education teachers and parents believe that if a hearing aid malfunctions, the child can survive by lipreading alone. There is also a noted lack of urgency in getting the aids repaired when malfunctions are reported, as if nothing of importance will be taught on those days.

A third problem is that many children with hearing loss spend

the majority, if not all, of the day in a regular classroom. In this situation, professionals with the knowledge and experience to check the hearing aids are not present to provide this service. This means that some professional in the school program must take the responsibility to teach the regular classroom teacher to do routine checks of the hearing aids, or someone else must be hired to perform this function.

A primary goal of educational audiologists is to be sure that every child starts the day with working amplification. With educational audiologists employed in school systems and hearing aids monitored daily, this goal is not unrealistic. This study found that daily monitoring of hearing aids can reduce the number of malfunctioning aids to less than 6%, with follow-up by school audiologists conceivably reducing it to less than 1%. Although hearing aid technology has improved tremendously, it will be negated by a dead battery.

Table 1. Percentage of malfunctioning hearing aids

	Year						
	1	2	3	4	5	6	7
August	5.6	1.8	1.4	14.2	1.7	2.9	2.8
September	6.0	8.9	3.1	4.8	4.6	2.4	7.4
October	13.5	9.1	4.1	4.1	2.6	2.2	1.4
November	9.0	13.5	5.6	3.5	8.7	1.6	2.3
December	4.4	13.3	2.0	3.8	2.0	1.6	2.5
January	2.7	13.5	6.9	3.0	12.4	3.6	3.5
February	2.8	15.7	6.3	3.1	5.6	5.2	3.9
March	3.6	14.2	2.7	3.3	5.5	5.6	3.3
April	4.0	9.7	2.6	10.1	9.1	5.2	8.7
May	3.7	5.5	3.6	6.3	5.9	1.2	4.6
Yearly %	5.5	10.9	3.9	4.3	7.1	3.0	4.

Table 2. Summary of malfunctions for seven years

Weak or dead battery	51.7%
Wrong setting	25.3%
Static or distortion	9.0%
Dead	3.0%
Earmold occluded	3.1%
Internal noise	2.7%
Broken battery door	2.6%
Moisture	1.0%
Cracked tubing	.7%
Feedback	.4%
Damaged cord	.07%

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