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Hearing devices for children with unilateral hearing loss: Patient- and parent-reported perspectives☆

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ABSTRACT

Objective: Management of children with unilateral hearing loss is not standardized. The primary goal of this study was to elicit patient- and parent-reported perspectives regarding usage of hearing devices in pediatric UHL and to suggest a basic algorithmic approach to management.
Methods: Our tertiary care center recruited families of youth ages 5–19 years with unilateral hearing loss from January 2014 through October 2015. Parents of all youths completed a 36-item survey, and some youth ages 11–19 years participated in hour-long interviews. We assessed patterns of hearing device usage among participants, and performed qualitative data analysis to understand factors considered by youths when deciding whether or not to use a hearing device.
Results: Survey information was collected for 50 patients. Distribution of hearing loss severity in affected ear was mild 14%, moderate 26%, severe 22%, and profound 38%. The majority of children had sensorineural hearing loss (57%), followed by mixed (32%), and then conductive (11%). 34 children (68%) had tried a hearing device; 20 continued to use the device. Retention rates were similar among children with different degrees of hearing loss: mild 66%, moderate 50%, severe 60%, profound 64%. Sixteen children tried a wireless contralateral routing of signal (CROS) device, and 15 tried a behind-the-ear (BTE) hearing aid. Retention rates for CROS and BTE devices were 69% and 47%, respectively. The most common reason for cessation of use was discomfort, followed by lack of benefit.
Conclusion: A majority of children with unilateral hearing loss who tried a hearing device continued to use it, and retention rates were similar across all degrees of hearing loss. These findings suggest that personal hearing devices should be included in management protocols.

1. Introduction

Newborn hearing screening has improved our ability to detect unilateral hearing loss (UHL) at an early age [1]. Reported prevalence of UHL among children 6–19 years ranges from 3 to 6.3% depending on case definition [2], and the prevalence of UHL may be increasing among adolescents [3]. Children with UHL have been found to have worse performance on speech and language tests than normal hearing siblings [4]. In addition, there is emerging evidence that early identification and intervention may improve speech and language skills of young children with UHL [5]. However, there are no evidence-based guidelines for management of pediatric UHL [6].

Options for management of pediatric UHL include monitoring without intervention, classroom accommodations such as preferential seating and frequency modulation (FM) systems, and individual hearing devices [7]. Some of the most common hearing devices include behind-the-ear (BTE) hearing aids, contralateral routing of signal (CROS) devices, and bone conduction sound processors (BCSP). Questions have been raised regarding how strongly to recommend individual-level hearing devices. For example, in

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1994 Updike suggested that conventional BTE aids and CROS devices may be detrimental to hearing based upon a case series of 6 children with UHL [8]. However, a slightly larger pilot study of 8 children with UHL found participants to report a subjective benefit with BTE hearing aids, but the group was limited to patients with mild to moderately severe UHL [9].

Overall, there have been few large studies evaluating benefit of hearing devices in pediatric UHL; therefore, there is limited evidence upon which providers can base their recommendations for management. The primary goal of this study was to elicit patient- and parent-reported perspectives regarding usage of hearing devices in pediatric UHL and to suggest a basic algorithmic approach to management.

2. Methods

This is a mixed-methods study utilizing both quantitative and qualitative approaches to exploring outcomes related to hearing device usage in pediatric UHL. The study was conducted at Seattle Children's Hospital, a pediatric tertiary care facility. Institutional Review Board approval was obtained prior to data collection (IRB#14753).

The institutional audiometric database was queried to identify all children diagnosed with UHL between January 2007 to July 2014. UHL was defined using the following criteria determined by behavioral audiogram: Normal hearing in one ear with 4-tone pure-tone average (PTA) of less than 30 dB HL, and contralateral 4-tone PTA of greater than or equal to 30 dB HL. Patients with conductive hearing loss, sensorineural hearing loss and mixed hearing loss were included, as long as audiogram results and medical history were consistent with permanent hearing loss.

Following identification, electronic medical records were reviewed to ensure that patients met the following criteria for participation: Age between 5 and 19 years, presence of permanent hearing loss, and absence of complex medical conditions that could potentially impact response to hearing device. In addition, families who expressed a preference to not be contacted for research were not approached.

After potential participants were identified, our research team contacted families by telephone to explain the details of the study and conduct telephone surveys. Additional patients who met the above criteria were also recruited from clinic. Parents of children ages 5–17 years were surveyed, along with youths who were 18 and able to consent for themselves over the telephone. The survey was developed by a panel of hearing health providers, including otolaryngologists, audiologists and an education consultant for children who are deaf or hard-of-hearing (D/HH). The survey consisted of 36 questions regarding health history, school performance and hearing device usage.

Survey data were collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at University of Washington's Institute for Translational Health Sciences [10]. REDCap is a secure, Web-based application designed to support data capture for research studies, providing an interface for data entry, audit trails for tracking data manipulation, and procedures for exporting data to common statistical packages. Following survey completion, data were exported from REDCap to Stata 13.1 (Stata Inc., College Station, TX).

In addition to the telephone survey, our research team also invited youths ages 11–19 years with UHL to participate in on-site interviews at Seattle Children's Hospital. Semi-structured interviews were conducted to explore multiple facets of their experiences living with UHL, some of which were specifically related to hearing device usage.

2.1. Analysis

Univariate analysis was carried out to calculate means and medians for continuous variables such as age, and proportions for categorical variables such as hearing loss severity. Logistic regression models controlling for age at diagnosis were created to assess the likelihood that a child would have exposure to a hearing device based upon degree of hearing loss and to determine whether duration of usage was associated with retention rates. In addition, comparisons were made between the most common hearing devices using a Student's t-test for continuous outcomes and Chi-square test for categorical outcomes. For all tests, $p < 0.05$ was considered statistically significant. Stata 13.1 (Stata Inc., College Station, TX) statistical software was used for all analyses.

The responses to the qualitative interviews were audio-recorded, transcribed and thematically analyzed using Dedoose software, a secure system for performing qualitative data analysis [11]. A codebook of 11 codes was developed based upon excerpts contained within the first 5 interviews. Following codebook development, two members of the research team independently coded the initial interviews. Discrepancies between code application were resolved through discussion among research team members. Once there was greater than 90% agreement in code application, remaining transcripts were coded by a single research team member. All transcript excerpts that related to patients' experiences with hearing devices were reviewed for this study.

3. Results

Our initial query identified 418 children with a behavioral audiogram meeting criteria for UHL between January 2007 and July 2014, with 187 children meeting criteria for inclusion. Common reasons for exclusion were 1) the presence of a reversible conductive loss, 2) development of bilateral hearing loss over time, and 3) presence of a syndrome or comorbid condition associated with major developmental delay.

Our research team surveyed 50 parents and conducted 16 interviews with youths from January 2014 to October 2015. Distribution of hearing loss severity in affected ear was mild 14%, moderate 26%, severe 22%, and profound 38%. The majority of children had sensorineural hearing loss (57%) followed by mixed (32%) and then conductive (11%). Characteristics of children and youths with UHL are included in Table 1. In summary, median age at diagnosis was 5 years. Age at time of diagnosis ranged from birth to age 10. There were 11 children who were diagnosed at birth. The most common reasons for diagnosis after birth were abnormal school hearing screen (27%) and parental concern for hearing problem (24%). Almost 1/3rd of the patients (31%) had progression of UHL over time.

Nineteen of the participants (38%) had been enrolled in an Individualized Education Plan (IEP) at their school at some point in time. Only 7 of the 19 children (37%) were enrolled in an IEP specifically for hearing impairment; 4 were enrolled for speech/language concerns (21%). None of the participants worked with a teacher for the deaf or hard-of-hearing, and all were participating in general education classrooms at the time of survey.

Families also reported on whether appropriate accommodation protocols were being carried out in schools. The vast majority, 40 (80%), reported that their child currently had access to preferential seating at school. However, a smaller proportion (40%) reported that schools were currently utilizing FM systems, either personal or soundfield, for classroom instruction. There were 26 children (52%) that had 504c plans outlining accommodation protocols.

Among the youths who completed interviews, 12 of 16 (75%) stated that they had access to preferential seating in class. However,