



Pediatric cochlear implantation: Role of language, income, and ethnicity



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ABSTRACT

Objective: To compare post-cochlear implantation (CI) early speech perception (ESP) outcomes between a non-English speaking, ethnic minority study group and an English speaking, ethnic majority control group.

Study design/methods: We performed a retrospective case-control study at an academic tertiary care children's hospital. Records were reviewed of 49 children who underwent CI from February 2005 to September 2011. Children with abnormal cognitive function ($n = 12$), post-surgical complications ($n = 1$), or incomplete SP testing ($n = 24$) were excluded. The remaining 12 cases (mean implant age 4.3y) were reviewed for language, income, ethnicity, and ESP scores. Their scores were compared to a subset of patients ($n = 18$; mean implant age 2.2y) serving as control from the Childhood Development after Cochlear Implantation (CDaCI) study at 1 year follow up where standard ESP testing was performed. Briefly, CDaCI includes a demographically balanced and multicenter-based pediatric cohort from which publications are beginning to define normative post-CI SP outcomes.

Results: Of our 12 children, 7 were Hispanic, 2 Caucasian, 2 multi-ethnicity and 1 Russian. 4 were non-English speaking, 5 spoke English as a second language, and 7 were bilingual. Three received bilateral CI. Mean early speech perception (ESP) scores (reported on a scale of 1–4) collected at 6 and 12 months in the study group were 1.71 and 1.75, respectively; in the control group, 3.83 and 3.92. At both follow up intervals the study group performed significantly worse than the control group (6mo $P = 0.048$, 12mo $P = 0.01$).

Conclusions: This study suggests that among pediatric CI recipients, those from predominantly non-English speaking, socioeconomically disadvantaged backgrounds develop SP at slower than normal rates. Future interventions should be directed at overcoming these obstacles.

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1. Introduction

Acquisition of spoken language relies on the ability to perceive and process external auditory signals. For children with severe hearing impairment who are unable to benefit from traditional

acoustic hearing aids, cochlear implants (CI) have been shown to improve speech and language outcomes [1]. However, there is wide variation in post-implant speech perception (SP) among pediatric patients. Some contributing factors include age at implantation, preoperative language ability, length of implant use, and mode of communication in rehabilitation [2–5]. Limited data exists, however, on the role of cultural background, socioeconomic status (SES), language, and family income in post-implant SP outcomes. These variables likely have a profound impact on postoperative rehabilitation, implant programming, and overall CI success. In order to optimize CI performance in children, the relationship of these variables to postoperative CI speech perception outcomes should be investigated. In this study, we

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Table 1
Characteristics of CI patients in the Bronx cohort.

Patient	Age at CI	Ethnicity	Bilingual	Primary language	Secondary language	ESP (6mo)	ESP (12mo)
1	7	Other	Yes	English	Arabic	NA	2
2	6	Hispanic	Yes	Spanish	English	1	1
3	1, 2	Other	No	Arabic	NA	NA	2
4	10	Hispanic	No	Spanish	NA	1	2
5	2	Hispanic	no	English	NA	NA	1
6	3	White	Yes	Romanian	English	NA	4
7	3	Hispanic	No	Spanish	NA	1	1
8	3	White	Yes	Albanian	English	NA	1
9	2	Russian	Yes	English	Russian	3	NA
10	5	Hispanic	No	Spanish	NA	3	NA
11	5	Other	No	Bengali	NA	1	NA
12	5, 6	Hispanic	Yes	Spanish	English	2	NA

compare post-CI ESP results of patients from a tertiary children's hospital in the Bronx, NY, a culturally and linguistically diverse group with below average household incomes, to a standardized national cohort.

2. Methods

We performed an institutional review board (IRB) approved, retrospective study at an academic tertiary care children's hospital. Records were reviewed of 49 children who underwent CI from February 2005 to September 2011. Children with abnormal cognitive function ($n = 12$), post-surgical complications ($n = 1$), or incomplete SP testing ($n = 24$) were excluded. The remaining 12 cases (implantation age 1–10y, mean 4.3y) were reviewed for language, income, ethnicity, and early speech perception (ESP) scores. Their scores were compared to a subset of patients ($n = 18$) from the Childhood Development after Cochlear Implantation (CDaCI) study using a two sample t test.

2.1. Early Speech Perception Testing (ESP)

Early speech perception is a test commonly used by audiologists to objectively measure the outcome and effectiveness of post-CI rehabilitation in children who were profoundly deaf. It is generally administered to children over the age of two who are able to choose between two presenting alternatives. Briefly, ESP employs a closed set, usually consisting of a picture plate of twelve items, to assess children's pattern perception, spondaic word identification, and monosyllabic word identification [6]. Scores are reported on a linear scale of increasing auditory skills from 1 to 4: detection (category 1), pattern perception (category 2), some word identification (category 3), and consistent word identification (category 4).

Table 2
Comparison of the average household income, ethnicity and language distribution in the Bronx and the CDaCI cohorts.

	Mean age at implantation (y)	Average household income (CDaCI reported as number and % of patients in each stratified bracket)	Ethnicity by % of population	Primary spoken language
Bronx CI population	4.3	\$22,500	Hispanic: 50% Black: 25% Other: 10% White: 9% Unknown: 6%	Spanish: 41% English: 25% Arabic: 0.8% Romanian: 0.8% Albanian: 0.8% Bengali: 0.8%
CDaCI population	2.2	\$100,000+: 31 (16%) \$75–100,000: 26 (14%) \$50–74,999: 31 (16%) \$30–49,999: 42 (22%) \$15–29,999: 22 (12%) <\$15,000: 15 (8%)	Hispanic: 20% Non-Hispanic or White: 71% Asian: 9%	English

2.2. Childhood Development after Cochlear Implantation Study (CDaCI)

CDaCI is a demographically balanced and multicenter-based pediatric cohort study that forms the basis for systematic evaluation of early CI outcomes in children. Specifically, it compares children with CI with an age-matched, normal hearing cohort across several domains including *oral language development, auditory performance, psychosocial and behavioral functioning, and quality of life*. It is a standardized, national cohort study from which publications are beginning to define normative post-CI SP outcomes [7].

The control group from the present study is derived from a small subset of the CDaCI patients consisting of eighteen children with comprehensive standard ESP assessment at 1 year follow-up [6].

3. Results

In our cohort of twelve children, seven were Hispanic (58%), two Caucasian (17%), two multi-ethnicity (17%) and one Russian (8%). Four were non-English speaking, five spoke English as a second language, and seven were bilingual. Mean age at implantation was 4.3 years. Mean household income was \$22,500 (Tables 1 and 2). Three received bilateral CI. Mean early speech perception (ESP) scores collected at 6 and 12 months are 1.71 and 1.75, respectively (Fig. 1).

The characteristics of the 188 children with sensorineural hearing loss who received CI in the CDaCI study have been extensively described by Fink et al. [7] in the original paper on CDaCI study design. Briefly, 71% are White, 9% African American, 5% Asian, 11% Other, and 4% declined to answer. The primary language spoken is English. The mean age at implantation was 2.2 years. 22%

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