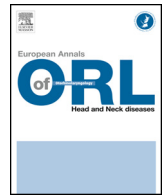




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Original article

# Long term results after cochlear implantation: Schooling and social insertion of teenagers and young adults



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## ABSTRACT

**Introduction:** To analyse the long-term impact of cochlear implantation (CI) in deaf patients on perception and language, and on schooling and social insertion.

**Method:** A total of 131 profoundly deaf patients that had unilateral CI, aged at follow up 16 to 26 years old and with 5 years minimum of follow up were included for the study. 84 of them had profound congenital deafness (Gc) and 47 had progressive deafness (Gp). In Gc, the mean age at CI was 5 years (3–16), the mean FU was 15 years. In Gp, the mean age at CI was 9 years (3–17 years), the mean FU was 11 years.

The perceptive scores (open set sentences (OSS), word in open set sentences (WSS)), the intelligibility rate (SIR), the lexical scores (EVIP) were analysed and compared to the Schooling Status (SS) & Social Insertion (SSSI) (University/Working/Handicapped environment) and Classified as (Mainstream or Specialized). Both groups were compared.

**Results:** The mean results for Gc and Gp respectively were for the OSS score: 67.1% and 80.7% ( $P=0.009$ ) and the SIR: 4.5 and 4.8 ( $P=0.049$ ). EVIP scores were: in Gc, 56% of patients had normal or  $\geq +1$  SD; in Gp 72% of patients had normal or  $\geq +1$  SD. The SSSI: 63% in Gc and 83% in Gp were in Mainstream Schooling. Low level of EVIP scores were linked to Specialized environment in both groups ( $P=0.01$ ,  $P=0.04$ ).

**Discussion:** Long-term results show that differences have to be expected whether implanted children had congenital or progressive deafness. In both groups, strong correlations remain between perceptive results, lexical scores and the SSSI.

**Conclusion:** On the long term the lexical level remains a relevant tool to assess the evolution of implantees. For those who do not reach a near to normal lexical level, impact on the schooling and the social insertion has to be expected.

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## 1. Introduction

Surgical indications for Cochlear Implantation (CI) have developed in recent years and are nowadays well defined. The first candidacy guidelines were published in 1995 [1]. The first generation of cochlear implant recipients have become older and are currently teenagers or young adults. As time goes on, it is becoming more possible to study and report on the long-term impact of auditory rehabilitation after cochlear implantation on educational achievement and social participation in these populations.

The aim of this study is to assess long-term results in a group of patients, teenagers and young adults aged 16 to 26 years old, after

cochlear implantation with regard to speech perception, speech production outcomes, and current academic and occupational status.

## 2. Population and methods

This retrospective study involved children implanted consecutively between 1993 and 2009 in the ENT department. Participants' data were analysed after review of medical records with respect to age at time of implantation, duration of follow-up, gender, type of deafness, and type of schooling.

Criteria for inclusion were current age between 16 to 26 years old with a minimum of 5 years follow-up. Exclusion criteria were lost to follow-up and current implant non-users. 11 out of 142 patients were excluded. 131 patients were included. The mean

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duration of follow-up after cochlear implantation was 13 years (6–22 years). Gender ratio was 0.91.

Type of hearing loss was divided into congenital hearing loss and progressive hearing loss. Participants with congenital hearing loss were further divided according to age at implantation into those implanted before the age of 3 years and patients implanted after 3 years old. The educational placement, or “schooling”, of participants was divided into 2 categories: mainstream vs. special education.

Speech perception, recognition, and intelligibility were analysed for all participants. Perceptive results were evaluated using the Open Set Sentences (OSS) test scores. Lexical level was assessed with the EVIP test (French-language adaptation of the Peabody Picture Vocabulary Test) (–2SD to +2SD). Speech intelligibility was estimated using the Speech Intelligibility Rating (SIR) scale [2], which consists of five levels ranging from 1 for unintelligible speech to 5 for speech intelligible to all listeners. All results were assessed using scores from latest follow-up.

Correlations between speech perception scores, linguistic level results, speech intelligibility and various variables (including educational setting and type of hearing loss) were analysed.

Statistical analyses were performed using Mann-Whitney, Dunn,  $\chi^2$ , and Spearman tests.

### 3. Results

Eighty-four out of the 131 patients studied had congenital profound hearing loss (Group Gcong) with a mean age at time of CI of 5 years (2–16 years). In addition, two sub-groups were studied: patients with surgery before age of 3 years (Gcong < 3 y) and after 3 years of age (Gcong > 3 y). Forty-seven patients suffered from progressive hearing loss (Group Gprog) with a mean age at time of CI of 9 years (3–17 years).

There was no statistical difference in patients’ current age or in gender ratio in both congenital deafness and progressive deafness groups.

At time of study, 9 patients were working. Seven of which were employed after at least two years of college education. The other two were in a work/study training program. Six patients were still searching for employment after college education. All other participants were still studying: 29% (34) at University, 31% (36) at high school, 40% (46) at technical college.

In the Congenital deafness group, 48 patients (63%) had mainstream schooling: 24 were in highschool at time of study, 18 were students at university and 6 were studying in a technical college. Whereas in the Progressive deafness group, 33 patients (83%) had mainstream Schooling: 12 were at high school, 18 University Students and 3 were studying in a technical college.

Of the patients with congenital deafness 37% were in a special education program as compared to only 17% of those with progressive deafness ( $\chi^2$ ;  $P < 0.005$ ).

### 4. Link between Audiological Scores and Variables

#### 4.1. Perceptive results

The perceptive scores showed that the mean Open Set Sentences (OSS) scores were 76%; with 70% of the population having an OSS score of > 65%. In Gcong < 3 y, Gcong > 3 y and Gprog the mean OSS scores were 87.4%, 61.6% and 80.4% respectively. OSS Scores were higher in Gprog than in Gcong (Mann-Whitney;  $P = 0.002$ ). Fifty percent of children in Gcong < 3 y had OSS scores > 73% whereas 50% of children in Gcong > 3 y had OSS scores > 33% (Spearman;  $P < 0.0001$ ).

While studying perceptive scores with the variable “Schooling” setting we found that 50% of patients in mainstream schooling had

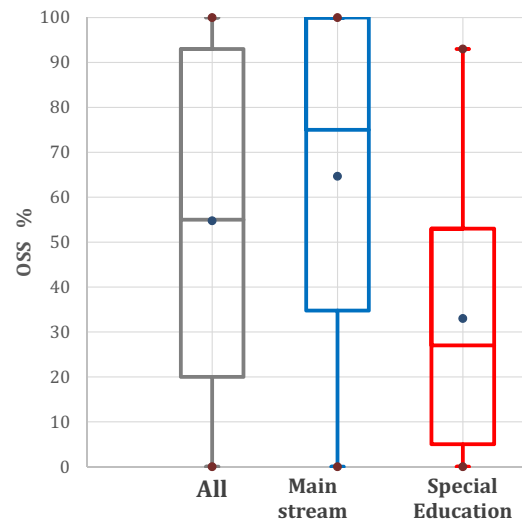


Fig. 1. Comparison between Scores in Open Set Sentences (OSS) between patients in Mainstream Education and patients in Special Education.

OSS scores greater than 73%. On the other hand, 50% of patients in a special education program had OSS perceptive scores < 27% (Mann-Whitney;  $P < 0.0001$ ) (Fig. 1).

#### 4.2. Lexical Level

General linguistic results with EVIP were: in congenital deafness group, 56% of patients had normal or  $\geq +1$  SD EVIP score; in the progressive deafness group 72% of patients had normal or  $\geq +1$  SD EVIP score. Patients in Gcong > 3 y had inferior EVIP score results than those in Gprog (Dunn Test;  $P = 0.004$ ). This was the only statically significant difference between the 3 groups for EVIP scores (no difference between Gcong < 3 y and Gprog, and no difference between Gcong < 3 y and Gcong > 3 y).

Studying Lexical Level with the variable “Schooling” setting: EVIP scores were higher in the group of patients with mainstream schooling than in the group of patients receiving special education (Mann-Whitney;  $P < 0.0001$ ) (Fig. 2).

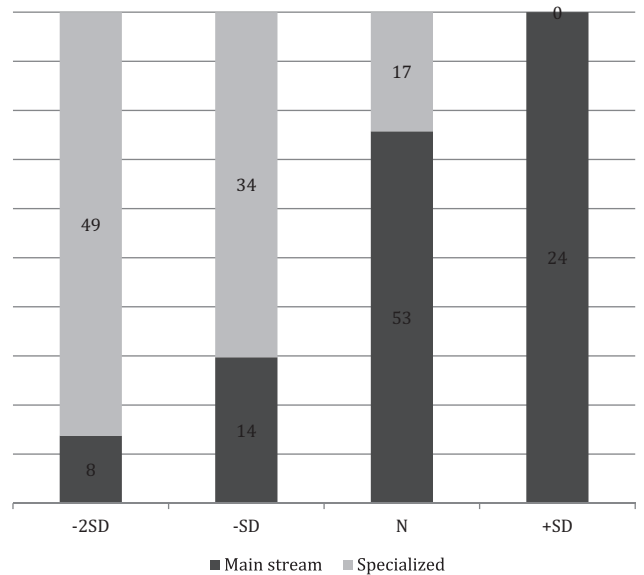


Fig. 2. Percentage of patient having EVIP score (French adaptation of Peabody Picture Vocabulary Test) –2SD to +1SD in patients in Mainstream Education and patients in Special Education.

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