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Original article

# Benefit of contralateral hearing aid in adult cochlear implant bearers

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ABSTRACT

*Objectives:* The present study assessed the interest of a contralateral hearing aid (HA) in adult cochlear implant (CI) bearers.
*Material and methods:* The study recruited 10 French-speaking adult HA bearers with postlingual bilateral hearing loss, fitted for at least 2 years with a unilateral CI after loss of benefit from HA in one ear but continuing to use their contralateral HA: 4 male, 6 female; mean age, 58 years. All had regularly used bilateral HAs prior to CI. Audiometric assessment comprised: (1) individual ear hearing assessment on pure-tone audiometry and speech discrimination; and (2) free-field testing without aid, with CI only, with HA only and with CI plus HA, on pure-tone audiometry and speech discrimination with quiet background and on speech discrimination in noise.
*Results:* Speech discrimination was significantly improved in the bimodal condition (CI plus HA) as compared to CI alone, on all tests. In quiet, discrimination for disyllabic words was > 50% in 7 cases with HA alone, in 2 cases with CI alone and in 1 case in with HA + CI. Under 0 dB signal-to-noise ratio, discrimination was > 50% in 1 case with HA alone, in 3 cases with CI alone and in 6 cases with HA + CI.
*Conclusion:* The present results showed benefit in auditory perception in quiet and in noise with bimodal stimulation. When there is residual hearing in the non-implanted ear, a HA should be fitted; and in progressive bilateral hearing loss, CI should be suggested when HA benefit decreases in one ear.


## 1. Introduction

Indications for cochlear implantation (CI) in adults with postlingual bilateral hearing loss are constantly evolving. Given the progress in technology and the rapid improvement in communication provided by CI, it can legitimately be suggested as soon as the benefit of a hearing aid (HA) begins to diminish in one ear. According to the French Health Authority (HAS) criteria, CI should be considered in adult bilateral HA bearers if there is only limited or no benefit of HA on one side and the patient ceases to use the device [1]. Conserved binaural hearing via bimodal stimulation (acoustic in one ear and electrical in the other) can improve speech discrimination in both quiet and noise [2].

The present study was conducted in a follow-up care network for implanted patients managed in the CI departments of the Paris hospitals board (Assistance publique–Hôpitaux de Paris [AP–HP]: Avicenne, Beaujon, Pitié-Salpêtrière and Tenon-Saint-Antoine Hospitals, and the Île-de-France Region CI Institute [IFIC]), to assess results with bimodal binaural stimulation, based on audiologic tests and questionnaires.

## 2. Material and methods

The study was performed in the IFIC as part of standard care for adult CI patients at least 2 years post-implantation. Selection was based on response to a dedicated questionnaire exploring the subjective benefit experienced with CI and contralateral HA (Appendix 1). Patients reporting benefit with continued use of their HA in association with CI were given audiologic assessment. A sample size of 10 was determined to allow the various assessments to be conducted within a 4-month period. All 10 patients were

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**Table 1**
Patient data.

| Patient | Age | Use of CI (years) | CI model | Hearing on HA side (dB)[a] | HA model |
|---|---|---|---|---|---|
| 1 | 39 | 10 | Cochlear Esprit 22 | 109 | Phonak Senso P38 |
| 2 | 71 | 6 | Cochlear Esprit 3G | 109 | Siemens 8DF |
| 3 | 74 | 5 | Med El Tempo | 81 | Widex C18+ |
| 4 | 61 | 4 | Cochlear Esprit 3G | 108 | Siemens Acuris |
| 5 | 50 | 4 | Cochlear Freedom | 60 | Siemens Nitro CIC |
| 6 | 51 | 4 | Cochlear Freedom | 98 | Siemens Centra SP |
| 7 | 49 | 4 | Med El Pulsar | 101 | Oticon Sumo DM |
| 8 | 73 | 3 | Advanced Bionics Harmony | 99 | Siemens 8DF |
| 9 | 31 | 3 | Cochlear Freedom | 84 | Phonak Savia 311 |
| 10 | 76 | 2 | Cochlear Freedom | 86 | Phonak |

HA: hearing aid; CI: cochlear implant.
[a] Arithmetic mean of air-conduction thresholds at 500, 1000, 2000 and 4000 Hz (BIAP guideline).

French-speaking adults: 4 male, 6 female; mean age, 58 years (range, 31–76 years) (Table 1). All had postlingual bilateral hearing loss, with various etiologies. Implantation and assessment were performed in one of the study departments. All patients had been using bilateral HAs when CI was indicated due to reduced benefit on one side, and in some cases abandonment of HA use on that side, which was therefore the side on which CI was performed. Post-CI follow-up was at least 2 years. HAs and CIs were of various brands and models (Table 1).

Audiometry was performed in the IFIC, using an Aurical Plus audiometer (GN Otometrics, Taastrup, Denmark) connected up to a computer running Noah software. Speech audiometry used dedicated CDs produced by the National Audioprosthetics College (Collège national d'audioprothèse; Carvin, France). Three loudspeakers were used for free-field testing: 1 frontal (0°) and 2 lateral (+90° and −90° with respect to the subject).

Audiometric assessment systematically comprised:

- pure-tone and speech audiometry via headphones, ear by ear, determining air-conduction thresholds for pulsed pure tones, and discrimination thresholds for Fournier's disyllabic word lists;
- free-field pure-tone audiometry, with oscillating sounds delivered without aid, with CI only, with contralateral HA only and with CI plus HA;
- free-field speech audiometry in quiet, using Fournier's disyllabic word lists, without lip-reading, delivered without aid, with CI only, with contralateral HA only and with CI plus HA;
- speech audiometry in noise, using Hint's sentence lists on CD, with "cocktail party" noise, delivered without aid, with CI only, with contralateral HA only and with CI plus HA. The signal was presented frontally and the noise laterally; signal level was 60 dB (SPL) and the signal/noise ratio ranged between −20 and +20 dB.

## 3. Results

### 3.1. Clinical

Table 1 presents the main clinical data for the series of 10 adults, aged 31 to 76 years (mean, 58 years), with a mean post-CI follow-up of 4.5 years. All were using unilateral CI with contralateral HA, for more than 12 hours a day; this was checked on the selection questionnaire results (Appendix 2).

### 3.2. Residual hearing

All patients had residual hearing contralaterally to the CI, with various pure-tone audiometry thresholds (Fig. 1). One patient (patient 5) had profound hearing loss without HA on one side and moderate but fluctuating loss on the other, causing problems for HA setting and use. This profile does not match the Health Authority criteria for CI, but implantation on the side with profound hearing loss was proposed due to the impact of the fluctuating deficit on everyday communication. Residual speech discrimination on the HA side, assessed by speech audiometry by headphones without aid, varied from patient to patient (Fig. 2). On the CI side, only 2 patients (patients 4 and 6) had residual hearing with

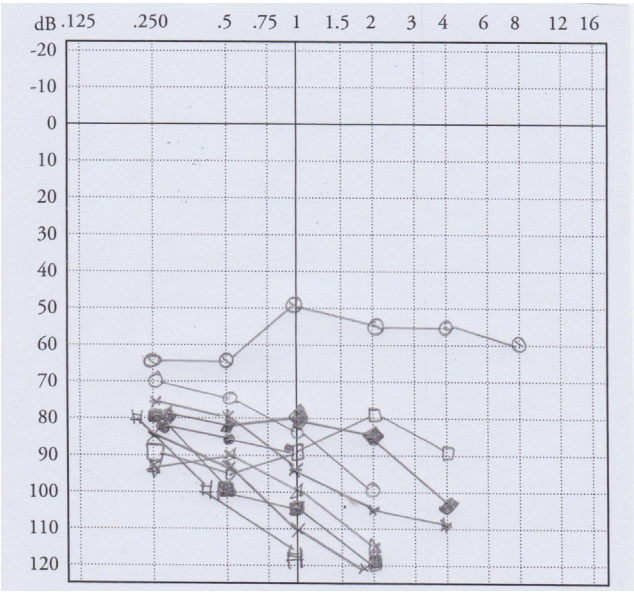


**Fig. 1.** Residual hearing contralateral to CI: severe to profound hearing loss on pure-tone audiometry.