Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods. Cognitive tests and quality-of-life assessment

Cognitive tests

The Mini-Mental State Examination (MMSE) is a commonly used screening test for likely cognitive impairment, with test components covering concentration, language, orientation in space and time, and memory (scores ranging from 0 to 30)[1]. Scores were adjusted according to age, gender and education level. A consensual French version of the MMSE was adapted by the Working Group on Cognitive Evaluations (GRECO) and normative data were established in patients aged 70 and younger[2]. Normal MMSE scores were considered as abnormal in this population if lower than the 5th percentile. In patients over 70, we used the norms established in 2004[3] (with abnormal scores if <10th percentile).

The Five Word Test (FWT) is a rapid test, screening episodic memory disorders, derived from the Enhanced Cued Recall Test[4].This is a recall task of a list of five words, presented in written format, each item belonging to a different category[5,6]. Two lists of words are available. The participant was first asked to repeat back the words in any order, to ensure their encoding and avoid attention deficit. If some words were lost, the semantic cues were provided. After several minutes during which another type of non-semantic task was presented, the participant was asked to repeat the five words in any order. The category cues were then used to elicit cued recall of only those items that were not retrieved by free recall. The number of free and cued recalls words was recorded. Scores lower than 10 were considered abnormal.

The Clock Drawing test measures numerous cognitive functions, especially visio-construction, and is widely used as a screening test for dementia. The subject was asked to draw, in a circle, all the numbers as a clock face, and to set the two hands indicating twenty minutes to four. Several scoring methods were published. We chose to use a scoring procedure, based on the presence of seven attributes: number 1-12 present without adding extra or omitting numbers, sequencing and position of numbers, 2 hands present, the hour hand pointing to 4, the minute hand pointing to 20, proportion of the hands[7]. The maximum score was seven and scores ≤ 4 were considered abnormal.

The Verbal Fluency test requires that the subject generates as many words as possible in a fixed period of 60 seconds from a given category. The categories are semantic (animal, fruit, furniture) and phonemic (beginning by the letter P, R or V- Letter fluency test). One point was given for each appropriate answer. Abnormal scores were assessed for each list as function of normative data, according to age, gender and education level[8].

The d2 test of attention assesses concentration speed and attention[9]. The items are composed of the letters "d" and "p" with one, two, three or four dashes arranged either individually or in pairs above and below the letter. The subject was given 20 seconds to scan each line and mark all "d" with two dashes. There were 14 lines of 47 characters each for a total of 658 items. Measures of performances included total number of items processed and total percentage of errors. Scores were considered abnormal if lower than the 10th percentile.

The Trail Making Test Parts A (TMT A) and B (TMT B) are time tests that measure visual scanning, speed of processing, mental flexibility, and executive functions. Subjects drew a line connecting randomly positioned numbers in consecutive order (TMT A) or alternative numbers and letters of the alphabet (TMT B). Scores were based upon the total time of test

completion without error, and interpreted using the normative data, according to age and education level[10].

Quality-of-life assessment

The Nijmegen Cochlear Implant Questionnaire (NCIQ) is a validated disease specific questionnaire composed of 6 subdomains: basic sound perception, advanced sound perception, speech production, self-esteem, activity limitations, and social interactions[11]. Each subdomain contains 10 items. Interrogative phrases in a negative format were recoded to allow scoring similar to the positive questions. Responses were scored as 0, 25, 50, 75, and 100. Missing value and the response "not applicable" were treated as not completed. Questionnaires with more than 3 missing values in one subdomain were excluded from analysis. Mean scores in each subdomain range from 0 (very poor) to 100 (optimal).

eReferences

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eTable 1: Patient demographics (n=94)

Age at implantation (yr), mean (SD, range, median)	72 (5.0, 65-85, 71)
Duration of hearing loss (yr), mean (SD, range, median)	
Implanted ear	30 (19.5, 1-77, 27)
Non-implanted ear	29 (20, 1-82, 27)
Duration of profound hearing loss (yr), mean (SD, range, median)	
Implanted ear	11 (15.1, 1-61, 5)
Non-implanted ear	11 (17.2, 1-82, 4,5)
Sex, No.	
Female	49
Male	45
Marital status, No.	
Married	66
Single, divorced, widower	28
Level of education, No.	
Elementary school	40
Middle school	26
High school diploma / Post-secondary education	28
Support[a]**,** No.	
Family	71
Friends	50
No support	4
Past medical history, No.	
None or minor pathologies	50
Hypertension	34
Cardiovascular events	17
Diabetes mellitus	8
Respiratory disease	5
Cancer	4
Etiology of deafness[b], No.	
Unknown	44
Otosclerosis	15
Menière's disease	12
Congenital/Familial	12
Traumatism	10
Chronic otitis	3
Meningitis	2
Ototoxicity	2
Use of hearing aids, No. implanted / non implanted ear	
Never	27 / 25
Abandoned before implantation	24 / 9
Hearing aid use	43 / 60

[a]patient may have both family or friend support. [b] patient may have several etiologies.

eTable 2: **Correlation analysis between the improvement of NCIQ and of speech scores at 12 months after cochlear implantation (compared to preoperative results).**

	Quiet		SNR + 15		SNR +10		SNR +5		SNR 0	
	r	*P* value	*r*	*P* value	*r*	*P* value	*r*	*P* value	*r*	*P* value
Basic sound perception	0.15	.14	0.09	.44	0.07	.54	0.02	.82	0.25	.11
Advanced sound perception	0.24	*.02*	0.25	*.03*	0.13	.29	0.12	.33	0.04	.70
Speech production	0.34	*.0010*	0.23	*.004*	0.26	*.03*	0.22	*.07*	-0.07	.55
Self-esteem	0.24	*.002*	0.22	*.06*	0.28	.20	0.26	*.03*	-0.05	.65
Activity	0.35	*.0007*	0.25	*.04*	0.27	*.02*	0.18	.12	-0.08	.48
Social interactions	0.33	*.0014*	0.28	*.02*	0.23	*.04*	0.04	.72	0.04	.73

Test material was disyllabic words presented at 60 dB in quiet and at different signal to noise ratio (SNR, dB) in best aided conditions. *r* is the Spearman correlation coefficient.

SNR: signal-to-noise ratio