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ORIGINAL RESEARCH

Cochlear implantation and quality of life in postlingually deaf adults: Long-term follow-up

Godelieve W.J.A. Damen, MD, Andy J. Beynon, MSc, PhD, Paul F.M. Krabbe, MSc, PhD, Jef J.S. Mulder, MD, PhD, and **Emmanuel A.M. Mylanus, MD, PhD,** Nijmegen, The Netherlands

OBJECTIVE: To investigate long-term quality of life (QoL) in postlingually deaf adults after entering the cochlear implantation (CI) program.

STUDY DESIGN AND SETTING: Follow-up study from 1998 onwards in tertiary university medical center. Long-term CI users, patients who have not received a CI, and relatively short-term CI users were re-evaluated six years after initial data collection in 1998 by using three questionnaires (NCIQ, HUI3, and SF36) and speech perception tests.

RESULTS AND CONCLUSIONS: In general, the beneficial effect of CI remained stable during long-term follow-up, though scores on the questionnaires decreased slightly. Outcomes before and after cochlear implantation were significantly different. The group without a CI demonstrated slightly decreasing trends in outcomes. Long-term speech perception performance improved in time.

SIGNIFICANCE: This is the first study to investigate long-term follow-up of CI patients, in all aspects of QoL combined with speech perception performance, in comparison with postlingually deaf adults without CI.

Cochlear implantation has proved to be a successful and effective treatment for severely and profoundly deaf individuals.[1] A cochlear implant (CI) enhances speech perception and speech production in adults and improves hearing in all respects. Over the past 10 years, the general health status of patients, often referred to as health-related quality of life (HRQoL), has received increasing attention. Several studies have shown that a CI leads to substantial improvement in HRQoL, for example in the domains self-esteem and social functioning.[2,3] Few studies have been conducted on the long-term effects of cochlear implantation on HRQoL. Previous work has shown that initial improvements in psychological status after cochlear implantation tended to subside one and a half years after surgery.[4] At present, little is known about the long-term HRQoL of postlingually deaf adults after cochlear implantation. This study aimed to gain more insight into changes in HRQoL in adult CI recipients during long-term follow-up.

BACKGROUND

In 1998, Hinderink et al developed a disease-specific health-related QoL questionnaire for adults with a CI: the Nijmegen Cochlear Implant Questionnaire (NCIQ).[5] To compare different aspects of HRQoL in a group of CI recipients, the authors administered the new NCIQ and two generic HRQoL instruments: the Health Utilities Index (HUI3) and the Medical Outcome Study Short Form (SF36). Results showed that cochlear implantation led to improvements in HRQoL.[6]

In the present study, six years after the initial assessment, the same three questionnaires were readministered to the subjects. Data from the first study were compared to the present data (2004) and statistical analyses were performed. The following HRQoL aspects were addressed: long-term effects of a CI on HRQoL, changes in HRQoL during follow-up, differences in HRQoL between 1998 and 2004.

From the Departments of Otorhinolaryngology (Drs Damen, Beynon, Mulder, and Mylanus) and Medical Technology Assessment (Dr Krabbe), Radboud University Nijmegen Medical Centre, the Netherlands.

Reprint requests: GWJA Damen, MD, Department of Otorhinolaryngology, Radboud University Nijmegen Medical Centre, Philips van Leydenlaan 15, PO box 9101, 6500 HB, Nijmegen, The Netherlands.

E-mail address: g.damen@kno.umcn.nl.

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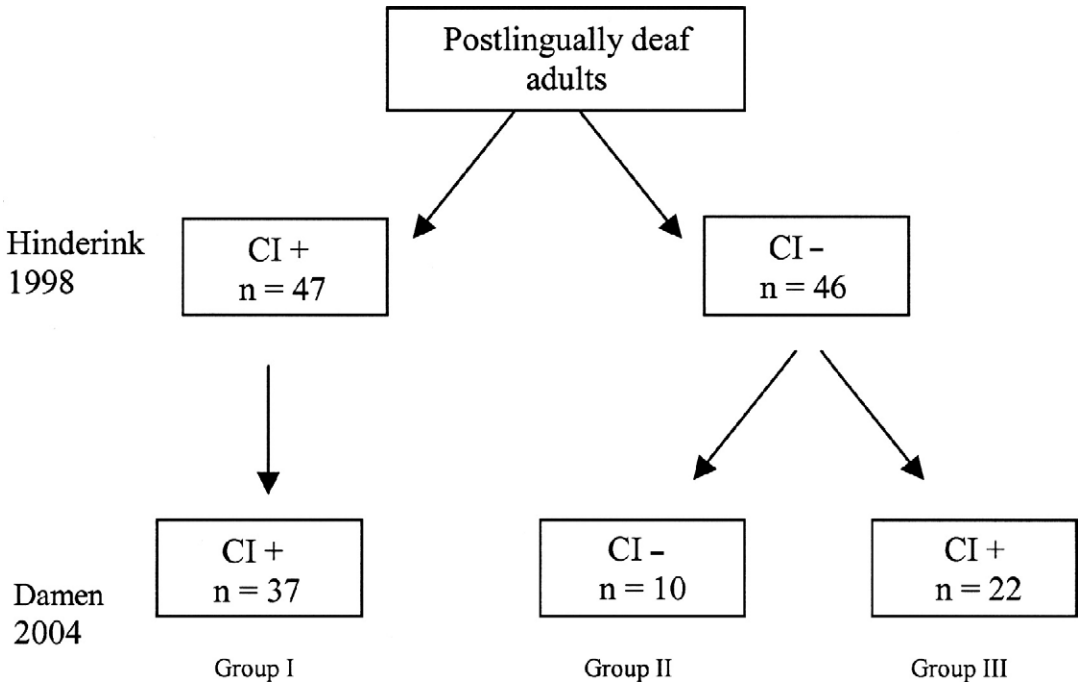

Figure 1 Demographic characteristics of the three groups who entered the CI program.

In addition, the results of the HRQoL instruments were evaluated in relation to speech perception scores.

PATIENTS AND METHODS

Study Population and Design

In 2000 inderink et al[6] used three questionnaires to evaluate HRQoL in 47 adult patients who had received a CI at the Radboud University Medical Centre Nijmegen between 1989 and 1997. All the patients were postlingually deaf adults (without any functional residual hearing) who had received a multichannel implant at least one year before entering the study. Their HRQoL scores were compared to those obtained from a control group of 46 postlingually deaf patients who were on the waiting list for a CI at our institute.

In April 2004, we contacted all the patients and control subjects (n = 93) and invited them to participate in the present study by filling in the same three questionnaires. A total of 37 out of the initial 47 CI recipients agreed (group I). The remaining 10 patients were excluded, because three had died, three were lost to follow-up, and four were unwilling to cooperate for various reasons.

In the initial control group of 46 patients on the waiting list for a CI, 29 patients had received an implant in the interval prior to the current investigation. Seven of them had to be excluded, because three had died, two were lost to follow-up, and two were unwilling to take part in the study. Questionnaires were therefore sent to 22 patients who had received a CI between 1999 and 2004 (group III).

The remaining 17 patients had not received a CI. Ten of them agreed to fill in the questionnaires and seven patients had to be excluded, because two had died, two were lost to follow-up, and three were unwilling to participate. These 10 patients (group II) had remained unimplanted for various reasons: fear, lack of motivation, unrealistic expectations, arbitrary residual hearing, and a long period of deafness.

Our study population therefore comprised three groups of patients: group I (CI users in 1998 and in 2004), group II (nonimplanted in 1998 and 2004), and group III (nonimplanted in 1998, implanted between 1999 and 2004) (Fig 1). Demographic characteristics are shown in Table 1.

In group I, four different types of CI had been implanted: eight Clarion C1 devices (Advanced Bionics Corp., California, USA), two Laura devices (Antwerp Bionic Systems, Antwerp, Belgium), 21 Nucleus 22M and six Nucleus 24M (Cochlear Corp., Englewood, Australia). In group III, two different devices had been implanted: 11 Clarion C1 and 11 Nucleus 24M devices. In all the cases, surgery had been uneventful and no complications occurred in the direct postoperative period.

Data obtained in the previous study were compared to data obtained in the present study. The subjects were not provided with their previous answers. The study was approved by the Institutional Review Board.

Health-Related Quality-of-Life Instruments

Three instruments were used to obtain data on HRQoL: the Nijmegen Cochlear Implant Questionnaire (NCIQ), the Health Utility Index (HUI), and the Medical Outcome Study Short Form 36 (SF36).

The NCIQ is a disease-specific HRQoL instrument.[5] It addresses three general domains: physical (communication-related), social, and psychological functioning. Each do-

Table 1
Demographic characteristics of the three groups who entered the CI program

Characteristic	Group I (n=37) '98: CI + '04: CI +	Group II (n=10) '98: CI − '04: CI −	Group III (n=22*) '98: CI − '04: CI +
Gender			
Male	46%	50%	68%
Female	54%	50%	32%
Paid employment			
Yes	41%	60%	27%
No	60%	40%	73%
Education level			
Lower	30%	20%	29%
Secondary	46%	60%	52%
Higher	24%	20%	19%
Living situation			
Alone	19%	30%	23%
With others (parents, partner)	81%	60%	77%
Care center	-	10%	-
Age (mean yrs, SD)	55.1 (16.0)	50.5 (21.9)	61.5 (13.1)
Age onset deafness (mean yrs, SD)	30.8 (16.6)	24.4 (30.6)	47.6 (15.4)
Age CI (mean yrs, SD)	45.2 (5.4)	-	57.0 (13.4)
CI use (mean yrs, SD)	9.9 (2.5)	-	4.4 (1.2)

CI +, patients with CI; CI −, patients without CI, on the waiting list (see text).
*Education level, age CI, and CI use n=21.

main has one or more subdomains. The physical domain has subdomains: basic sound perception, advanced sound perception, and speech production. The social domain consists of two subdomains: activities and social functioning. The psychological functioning domain has one subdomain: self-esteem. Each subdomain contains 10 items. These items are formulated as statements with five answer categories that vary from "never" to "always" (55 statements) or from "no" to "good" (five statements). If a statement does not apply to a patient, a sixth answer can be given: "not applicable." After computation, the scores on the subdomains range from 0 (very poor) to 100 (optimal).

The second questionnaire was the Health Utility Index (HUI) mark 3, a 15-item self-report health-status classification.[7] It provides a description of the health status of subjects and consists of eight subdomains: vision, hearing, speech, ambulation, dexterity, emotions, cognition, and pain, with five or six response levels per item that vary from disabled to normal.[8] The HUI3 has proved to be a reliable, responsive, and valid instrument in a wide variety of clinical studies.[7] Classifications on the eight domains provide all the information necessary to calculate a single metric HRQoL summary score. These summary scores (also called utility scores) range from 0 to 1 on a generic scale, in which a value of 0 means as bad as being dead and a value of 1 means perfect health.[9] Health utility scores also proved useful in cost-utility analyses and related studies.[7]

The third questionnaire was the Medical Outcome Study Short Form 36 (SF36) that is based on a battery of health status instruments employed in the Medical Outcomes Study.[10] This questionnaire is a non–disease-specific, generic HRQoL instrument. It contains 36 items that measure eight domains: physical functioning, role functioning due to physical health problems, role functioning due to emotional problems, bodily pain, vitality, social functioning, mental health, and general health perceptions. The number of response choices per item range from two to six. Item scores on each dimension are coded, summed, and transformed onto a scale from 0 to 100, in which higher scores indicate better self-perceived health. A physical component summary score (PCS) and a mental component summary score (MCS) can be computed using the standardized scoring system.

Auditory Test Material

Two Dutch standardized speech perception tests on CD were used: the NVA test (an open speech recognition test that consists of monosyllabic word lists)[11] and two subtests from the Antwerp-Nijmegen test battery, AN test, to assess suprasegmental identification (a closed-set spondee identification test and a closed-set number of syllables test).[12] All auditory tests were presented at 70 dBSPL (conversation level) in a double-walled soundproof room with low reverberation. At least two lists consisting of 11 monosyllables each were presented for the NVA tests; phoneme scores were obtained.

Statistical Analysis

Long-term effects of CI use were determined by comparing the results obtained from group I in 1998 and 2004. For baseline purposes, ie, to study differences over time regardless of cochlear implantation, we reviewed the two sets of results obtained from the subjects who had not received a CI

Table 2
NCIQ results

	Group I (n=37)			Group II (n=10)		Group III (n=22)	
NCIQ	Pre CI	'98 CI+	'04 CI+	'98 CI−	'04 CI−	'98 CI−	'04 CI+
Sound perception basic	3.2 (6.0)	65.5 (24.2)	60.7 (25.1)	17.3 (15.2)	15.0 (14.7)	10.0 (13.8)	63.5** (23.2)
Sound perception advanced	14.6 (11.7)	55.2 (19.3)	54.4 (20.0)	27.1 (9.1)	22.5 (10.9)	14.6 (10.8)	51.7** (21.1)
Speech production	60.5 (20.7)	83.3 (17.6)	83.3 (17.7)	56.4 (16.0)	41.6** (17.0)	68.8 (18.3)	80.3 * (17.7)
Self-esteem	43.0 (20.1)	67.7 (17.2)	66.8 (19.2)	52.5 (19.7)	44.9 (21.4)	43.6 (20.7)	69.4** (13.0)
Activity	50.0 (21.9)	75.1 (16.0)	73.6 (19.6)	44.2 (16.3)	48.7 (18.4)	45.0 (23.9)	71.7** (18.2)
Social interactions	53.7 (18.0)	74.5 (14.1)	63.7** (14.8)	51.9 (10.3)	44.9 (12.8)	42.0 (21.4)	60.6** (14.2)

Means and standard deviations (between parentheses) on the domains of the NCIQ. Significant changes after six years are indicated with an asterisk (Wilcoxon's signed rank).
*$P < 0.05$; **$P < 0.01$.

(group II). By comparing pre- and post-CI results of 1998 (group I) and 2004 (group III), the potential change in benefit of CI could be established in two sequential groups of patients.

Besides the diverse domain scores, mean scores for the NCIQ and SF36 were determined as well as the utility score of the HUI3.

Scores on the three instruments were declared as missing values if nothing was filled in or if ambiguous information was provided. The maximum number of incomplete answers for a specific subdomain of the NCIQ was arbitrarily set at three items per domain; above this number the domain was not scored. As the distribution of scores on the majority of separate domains appeared to be skewed, nonparametric tests (Wilcoxon's signed rank exact tests) were used to analyze whether the scores obtained from the three groups were statistically significantly different. The same statistics were used to analyze audiological data. Pearson and Spearman correlation analyses were computed to identify the statistical relation between diverse domains and implant variables. Analyses were done by using SPSS software package 12.0.

RESULTS

Health-Related Quality-of-Life Measurements

Table 2 presents the mean NCIQ outcomes. In group I, there was very little change over time. Statistically significant deterioration was only seen in the domain "social interactions"; 32 out of the 37 patients had poorer scores in the 2004 evaluation.

In group II, scores on all but one of the NCIQ domains decreased over time (ie, showed deterioration in HRQoL). Only the domain "speech production" decreased significantly.

The potential change in benefit of cochlear implantation was established by comparing pre- and post-CI results obtained from two sequential groups of patients in 1998 (group I) and 2004 (group III). In 1998, the NCIQ showed significant improvement in all the domains after implantation. The same effect, with comparable size, was seen in 2004. Changes in the mean scores of group I over time on the NCIQ showed that long-term HRQoL had decreased slightly during the further six years of CI use, although not statistically significantly (Fig 2A).

Nevertheless, the beneficial effect of the CI was still clearly apparent compared to the preimplantation scores. Mean scores in group I and group II obtained in 1998 and 2004 had the same slope, which demonstrated minor deterioration over time. The beneficial effect of cochlear implantation was visible in the parallel increasing slopes in group I and group III after implantation, which indicated a similar significant benefit of cochlear implantation in the present study and the former study by Hinderink et al.

Most utility scores from the HUI3 (Table 3) did not alter significantly in group I in the long term, although the "pain" domain seemed to show a slight significant decrease. There was a general trend towards slight deterioration in HRQoL, but the amount of change rarely reached significance. The HUI3 did not detect any significant changes in group II over time. Comparison of preimplantation and postimplantation data showed similar effects in 1998 and 2004: the same three domains ("hearing," "emotions," and the total utility score) improved significantly. Although the HUI utility score (Fig 2B) decreased over time, the final results were still significantly better than those obtained before cochlear implantation (pre-CI vs long-term post-CI 2004: $P > 0.01$). In Figure 2B, similar slopes are visible in group I and group II between 1998 and 2004. The increase in HUI utility score after cochlear implantation in group III (2004) was also significant, but to a smaller extent than in 1998 (Table 3).

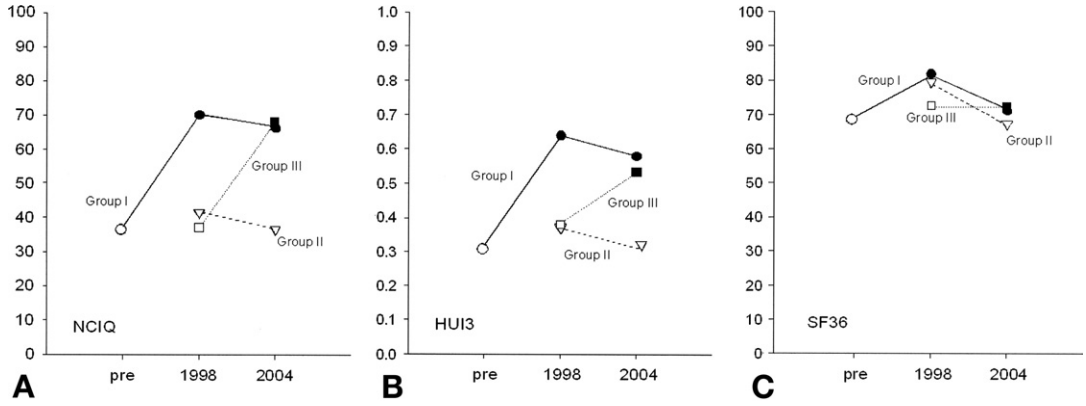

Figure 2 Mean questionnaire scores obtained at each measurement session. **(A)** NCIQ scores, **(B)** HUI3 scores, **(C)** SF36 scores. Group I, CI users in 1998 and 2004; group II, no CI in 1998 or 2004; group III, no CI in 1998, CI in 2004. Open symbol, no CI; filled symbol, with CI.

Table 4 shows that the SF36 detected greater decreases in HRQoL in the long term than the NCIQ and the HUI3. In group I, all eight domains deteriorated over the years, five of them statistically significantly (Table 4). The physical and mental summary scores also decreased statistically significantly. Time effects in group II were ambiguous on the SF36; only the scores on the "physical functioning" domain decreased significantly.

The SF36 benefit scores for cochlear implantation measured in 2004 (group III) were compared to the results of the previous study (1998). Whereas in 1998 all but two domains ("pain" and "vitality") improved significantly, in 2004 only "mental health" and the mental summary score increased significantly. The "general health" domain had not been measured before implantation in 1998. Results on the eight domains were combined into one mean SF36 score (Fig 2C). Deterioration in group I ran parallel with that in group II. This decrease was significant in group I ($P < 0.01$), in which 25 out of the 37 patients had a poorer score in 2004, but not significant in group II ($P = 0.08$). Group III showed a small, nonsignificant increase after cochlear implantation that was less apparent than the increase in mean SF36 score in group I after cochlear implantation in 1998.

Generally, the long-term benefit of a CI on HRQoL remained stable, but the effects were less clear on the generic SF36 than on the NCIQ and the HUI.

Follow-up of Speech Perception after Implantation (Group I)

Follow-up speech perception scores were not obtained from nine patients for different reasons (emigration, unwilling to cooperate, illness).

The two subtests of the Antwerp-Nijmegen test battery showed relatively high scores. During long-term follow-up, the mean AN spondee percentage in group I hardly changed: 82% in 1998 compared to 88% in 2004. Similar scores were obtained on the syllable identification test (80% in 1998; 82% in 2004). Figure 3 shows that the patients had lower scores on the speech recognition NVA test than on the AN test. Significant improvements in the NVA word scores

Table 3
HUI3 results

		Group I (n=37)		Group II (n=10)		Group III (n=22)	
HUI3	Pre CI	'98 CI+	'04 CH−	'98 CI−	'04 CI−	'98 CI−	'04 CI+
Vision		93.9 (16.0)	93.7 (16.0)	97.0 (2.6)	95.7 (1.8)	95.7 (1.8)	93.7 (1.8)
Hearing		56.6 (22.1)	55.1 (24.9)	19.3 (31.1)	13.8 (20.5)	13.8 (20.5)	59.2** (23.5)
Speech		95.3 (10.4)	94.2 (12.9)	75.5 (17.7)	90.1 (17.4)	90.1 (17.4)	94.4 (9.8)
Ambulation		98.7 (6.0)	96.8 (8.6)	98.3 (5.4)	96.3 (14.0)	96.3 (14.0)	92.6 (16.4)
Dexterity		98.2 (9.2)	97.9 (9.4)	98.8 (4.8)	96.4 (17.1)	96.4 (17.1)	98.9 (3.5)
Emotion		94.9 (5.8)	91.5 (15.7)	96.4 (4.7)	90.0 (14.9)	90.0 (14.9)	97.6 * (4.1)
Cognition		96.9 (12.1)	95.8 (8.9)	84.6 (20.9)	96.3 (9.1)	96.3 (9.1)	84.2 (26.7)
Pain		93.1 (11.4)	87.8* (20.2)	91.6 (15.8)	91.9 (9.9)	91.9 (9.9)	85.1 (24.8)
HUI 3 utility	0.32 (0.15)	0.64 (0.20)	0.37 (0.22)	0.37 (0.22)	0.31 (0.18)	0.38 (0.21)	0.53 * (0.24)

Means and standard deviations (between parentheses) on the domains of the HUI3. Significant changes after six years are indicated with an asterisk (Wilcoxon's signed rank).
*$P < 0.05$; **$P < 0.01$.

Table 4
SF36 results

	Group I (n=37)			Group II (n=10)		Group III (n=22)	
SF36	Pre CI	'98 CI+	'04 CI+	'98 CI−	'04 CI−	'98 CI−	'04 CI+
Physical functioning	88.4 (18.5)	86.6 (20.4)	80.5 * (22.5)	86.0 (17.5)	74.6 * (25.0)	76.0 (30.0)	68.6 (27.2)
Social functioning	58.1 (28.0)	85.1 (20.0)	77.1 * (22.3)	77.5 (22.7)	73.8 (23.2)	76.7 (26.5)	79.0 (26.8)
Role functioning (physical)	57.4 (40.8)	83.1 (33.4)	70.6 (38.7)	80.0 (30.7)	52.5 (44.8)	61.4 (40.6)	58.3 (43.5)
Role functioning (emotional)	62.2 (39.4)	86.5 (30.9)	71.6 (39.5)	86.7 (28.1)	50.0 (42.3)	68.3 (37.2)	81.8 (36.5)
Pain	88.4 (17.6)	84.5 (17.1)	76.9 (28.1)	83.5 (21.1)	85.0 (20.7)	80.8 (21.5)	80.3 (25.7)
Mental health	63.1 (18.8)	78.2 (16.7)	70.9 * (21.4)	74.8 (17.7)	66.0 (19.4)	74.4 (16.1)	82.7 * (16.1)
Vitality	68.7 (18.0)	72.4 (17.8)	62.9** (22.8)	66.0 (19.8)	71.7 (30.0)	68.9 (19.8)	67.5 (25.6)
General health perception	-	74.9 (18.9)	61.4** (25.2)	70.0 (22.1)	60.9 (26.5)	66.8 (21.4)	61.6 (21.5)
Physical summary score	-	51.6 (8.7)	48.3** (10.4)	50.7 (7.6)	48.1 (12.4)	47.2 (10.1)	43.0 (11.9)
Mental summary score	-	52.4 (9.8)	47.9** (12.9)	50.1 (8.8)	45.3 (11.6)	49.5 (8.7)	54.5 * (10.1)

Means and standard deviations (between parentheses) on the domains of the SF36. Significant changes after six years are indicated with an asterisk (Wilcoxon's signed rank).
*$P < 0.05$; **$P < 0.01$.

and phoneme scores were seen over time in group I (tested by Wilcoxon's signed rank exact tests for dependent variables): from 24% in 1998 to 36% in 2004 and from 45% in 1998 to 60% in 2004, respectively (Fig 3). When mean scores of the different instruments were analyzed together with the previously mentioned speech perception scores, some relations were detected: the mean NCIQ total score correlates significantly with AN syllable scores and the NVA phoneme test, the SF36 does not correlate significantly with any of the speech perception scores and the HUI utility score shows significant relation with the AN syllable-test, NVA word and phoneme scores (Table 5). Analyzing relations between the audiological test results and the individual instrument domain scores did not show clear relations.

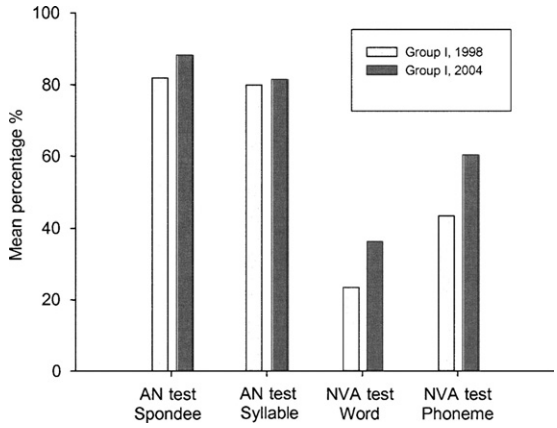

Figure 3 Mean speech perception test results in group I (CI users in 1998 and 2004) on the AN spondee and syllable tests and on the NVA word and phoneme tests are shown.

DISCUSSION

In the current long-term follow-up study, cochlear implantation and multiple aspects of specific and generic HRQoL were combined with utility scores. To our knowledge, this is the first publication on this issue. Our results showed that the beneficial effects of a CI on HRQoL were stable in the long term. Especially the hearing-related HRQoL scores (NCIQ) increased after cochlear implantation and this beneficial effect remained clearly visible. Nevertheless, a small but nonsignificant trend towards deterioration was observed over time. A similar trend was detected in group II, which suggests that the decline was not necessarily connected with cochlear implantation. The deterioration could, for example, be a natural effect of aging. Group III showed beneficial effects of cochlear implantation similar to those found in 1998. The positive effect of a CI on QoL has been described

Table 5
Correlation instrument results and speech perception results

	AN test		NVA test	
	Spondee	Syllable	Word	Phoneme
NCIQ	0.24	0.48**	0.29	0.32*
SF36	0.05	0.03	0.09	0.20
HUI3	0.20	0.33*	0.30*	0.39**

Spearman rho results of correlation analyses on mean QoL scores and speech recognition tests. Spearman rho correlations not found on the three instruments. Significant correlations are indicated with an asterisk (Wilcoxon's signed rank).
*$P < 0.05$; **$P < 0.01$.

by others, although not many researchers used the NCIQ.[1,2] Recently, Cohen et al[13] used the NCIQ (but no generic instruments) to compare HRQoL between 26 CI users and 30 hearing aid (HA) users, all with postlingual deafness. The results of their analyses supported the value of this instrument in the HA group and CI group. They found beneficial effects of a CI in all the subdomains,[13] which were equivalent to our results. As these authors had not used generic HRQoL instruments, it was not possible to compare the effect of a CI on hearing-specific and generic HRQoL.

In group I, the Health Utility Index mark 3 did not show any significant changes in the long term. All the domains and the utility score reflected a small but nonsignificant decrease in HRQoL. Utility scores in group I and group II showed comparable deterioration, which was also apparent in the mean NCIQ scores. These findings may confirm our hypothesis on the natural effects of aging. Similar deterioration in HUI scores over time was described by the UK group in cochlear implant patients.[14] In group III, scores on four of the domains increased after implantation (two of which increased statistically significantly), whereas an equal number of domain scores decreased. The utility score of group III improved significantly after they had received a CI. Only one other study reported the use of the HUI mark 3 to determine changes in HRQoL after a CI, but this was in 22 prelingually deaf children.[15] The smaller level of improvement in our study than in the report by Cheng et al[15] could be due to the fact that all the patients in our study group were postlingually deaf adults.

In our long-term evaluation, a significant decrease was detected in five out of the eight SF36 domains. Group II results were ambiguous and did not show any type of trend. In general, these unclear findings seem to confirm the variable SF36 results after cochlear implantation mentioned by Krabbe et al.[6] Group III results showed only one significant increase (in the domain of mental health), whereas in 1998, five domains had shown a strong increase after implantation. A lack of sensitivity of the SF36 to detect changes in HRQoL after cochlear implantation was also seen in an earlier study on 27 postlingually deaf adults[16] and in a number of Usher type I subjects who had received a CI.[17] As far as we know, these are the only studies that used the SF36 in CI patients, although the instrument has been used before in hearing-impaired adults. According to the literature, the SF36 lacks the necessary sensitivity to detect clinically meaningful improvements in patients with hearing impairment.[18] Therefore, on the basis of the previous and present observations of low sensitivity, we believe that the SF36 should not form the first choice of generic QoL questionnaire to evaluate hearing-impaired patients.

It has been reported that HRQoL and utility scores are based on two main factors: the dimensions used to describe a person's health state and the technique used to assign a value to the health state descriptions elicited by each of the HRQoL questionnaires.[19] The Health Utilities Index focuses on a person's capability to undertake certain tasks, such as hearing and speech (production), but it does not consider the implications of any impairments. In contrast, the SF36 focuses on performance rather than the underlying level of impairment. This could be an additional explanation for the difference in outcomes and trends between the HUI and the SF36.

Long-term effects of a CI on speech recognition tests showed progressive increases in suprasegmental scores and segmental speech perception tests. In group I patients, the initial improvement in speech recognition after cochlear implantation increased significantly over the subsequent six years. This is an impressive finding, because other authors have demonstrated no increase in speech perception outcomes[15,20] or only improvement over a shorter follow-up period.[21]

CONCLUSIONS

The initial benefit of cochlear implantation in a group of postlingually deaf adults was found to be stable in the long term, although the HRQoL scores decreased slightly over time. This decreasing trend was observed with the hearing-specific NCIQ and the utility-based HUI3. On the whole, the benefit of a CI was maintained, which is an important finding with respect to cost-benefit analyses and very encouraging for policymakers and health care providers. The SF36 was also used, but it showed ambiguous results. We feel that this instrument should not be the first choice of generic QoL questionnaire in further CI research projects. The control group (who had not received a CI) showed the same slight decrease in QoL as the long-term CI users. The currently reported beneficial effects of cochlear implantation on quality of life were equal to the former results from 1998. Speech perception scores still continued to increase over time, even after long-term CI use.

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