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Cochlear implantation in Thailand

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Abstract
This article evaluates and compares the benefits of a House/3M single channel cochlear implant or a Nucleus 22-channel cochlear implant on speech recognition in Thai-speaking patients. From 1986-1989, four profoundly deaf adults were implanted with the House/3M prosthesis. Since 1994, nine post-lingually deaf adults and three pre-lingually deaf children have been implanted with the Nucleus prosthesis. One case was implanted with the House/3M prosthesis and in the contralateral ear with the Nucleus prosthesis. The post-operative results were determined according to the ability to understand Thai monosyllabic, bisyllabic open-word sets and everyday sentence tests with, and without, lip reading. The scores were then compared in the House/3M users and the Nucleus users and compared between the House/3M cochlear implant and the Nucleus cochlear implant in the same user. The speech recognition scores on monosyllabic and bisyllabic open-word set demonstrated that the Nucleus users perform at a much higher level than the House/3M users. The results of four pre-lingually deaf children will be reported later after a period of auditory and speech rehabilitation.

Key words: Cochlear implant; Thailand

Introduction

The first case of cochlear implant (CI) in Thailand was operated in October 1986. Since then four post-lingually deaf adults have been implanted with the House/3M prosthesis, and nine post-lingually deaf adults and three pre-lingually deaf children with the Nucleus prosthesis. All of them are Thai-speaking patients. Thai is a tonal language composed of monosyllabic phonemes similar to the Chinese language. One phoneme may have four or five tones and each tone has a different meaning. Many articles reported the benefits of single channel CI and different kinds of multi-channel CI eg. Nucleus (Dowell *et al.*, 1986; Hollow *et al.*, 1995), Ineraid (Parkin *et al.*, 1993; Boex *et al.*, 1996), UCSF/storz (Kessler, D. K. *et al.*, 1986), Clarion (Battmer *et al.*, 1995; Loeb and Kessler, 1995) for English, Japanese and Chinese. These articles indicated that both single channel and multichannel CI can improve auditory and communicative abilities to a variable degree even in groups of patients implanted with the same device and speaking the same language. They (Eyles *et al.*, 1995; Huang *et al.*, 1996) also indicated that the improvement attained from a multi-channel CI is significantly better than a single channel. Our experience will illustrate the efficacy of the House/3M CI and the Nucleus CI on patients who speak Thai. This article is the first article dealing with Thai-speaking patients who have received cochlear implants. It reports the surgical results in 15 Thai-speaking patients using four House/3M single channel CI and 12 Nucleus 22-channel CI. One of the 15 patients received the House/3M CI and the Nucleus CI in the contralateral ear.

Patients and methods

Patients

Patients were selected for implantation using the following criteria:

(1) bilateral profound or total deafness;
(2) post-lingually deaf adults and pre-lingually deaf children with a range in age from two to six years;
(3) no significant benefit from an appropriate hearing aid;
(4) no medical or radiological contra-indication as evaluated by computed tomography (CT) scan of the cochlea;
(5) appropriate expectation of benefit of CI.

The House/3M prostheses were implanted using a 'C' post-auricular incision and the Nucleus prostheses using an 'inverted L-shaped' post-auricular incision via a posterior tympanotomy approach with no serious complications. The House/3M patients were implanted between 25 and 54 years of age with a mean age of 39.25 years. The Nucleus patients were implanted between three and 58 years of age with a mean age of 27.3 years. The cause of deafness,

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TABLE I
PATIENT DEMOGRAPHICS

Patient	Age	Sex	Duration of deafness (years)	Date of implantation	Aetiology	Type of CI
1	40	M	5	4–1986	Progressive HL	House/3M
2	44	M	10	7–1986	Electric shock	House/3M Rt. ear
	54		20	7–1996		House Lt. ear
3	52	M	20	7–1988	Progressive HL	House/3M
4	21	M	1	3–1989	Car accident	House/3M
5	56	F	25	8–1994	OM	Nucleus
6	51	F	3	10–1996	Progressive HL	Nucleus
7	41	F	3	12–1996	Meningitis	Nucleus
8	20	F	6	2–1997	Progressive HL	Nucleus
9	33	F	1	3–1997	Mumps	Nucleus
10	58	F	20	4–1997	Streptomycin	Nucleus
11	34	M	6	5–1997	Meningitis	Nucleus
12	18	F	2	9–1997	Congenital HL Progressive HL	Nucleus
13	4	F	4	6–1998	Congenital HL	Nucleus
14	6	M	6	8–1998	Congenital HL	Nucleus
15	3	F	3	11–1998	Congenital HL	Nucleus

CI = cochlear implant; HL = sensorineural hearing loss.

age at time of implantation, duration of deafness at time of implantation, date of implantation and type of CI are shown in Table I.

Method

Post-operative assessment of the speech recognition includes close-set and open-set test batteries. We report only the results of the open-set tests using the CI with, and without, lip reading as percentage scores. The open-set test battery consists of 25 monosyllabic phonetically balanced (PB) words, 25 bisyllabic PB words and 15 every day sentences. All of them are presented by a male live voice without the use of a microphone. Every three months post-operatively, the same series of tests are presented to the patients using the CI system. Data presented in this article is the most updated data.

Results

We divided the results into three categories. There were results on the House/3M patients, the Nucleus patients and results on the same patient using the House/3M in the right ear and the Nucleus prosthesis in the left ear. The House/3M patients included four men who ranged in age at the time of implantation from 25–54 years. There was no result for patient 1 because the device did not work one year after implantation. Patient 2 received the House/3M prosthesis in the right ear and the Nucleus prosthesis in the left ear 10 years later. The results of four House/3M patients are shown in Table II.

Table II shows percentage of words heard correctly after CI with and without lip reading. It demonstrates that percentage of words heard correctly after CI by patients 2, 3 and 4 (four to eight per cent) are low when compared to the percentage heard correctly by chance (four per cent). However, the percentage heard correctly after CI with lip reading (mean score = 60.67 per cent) were much

TABLE II
RESULTS OF THE HOUSE/3M CI PATIENTS

Patient	Word set	LR (% correct)	CI (% correct)	LR+CI (% correct)
1*	Monosyllabic	28	–	–
	Bisyllabic	32	–	–
2	Monosyllabic	28	8	44
	Bisyllabic	28	8	80
3	Monosyllabic	12	4	48
	Bisyllabic	12	4	72
4	Monosyllabic	28	4	40
	Bisyllabic	44	4	80

Patient 1*, non-user; LR = lip reading; CI = cochlear implant. Chance score is four per cent correct

TABLE III
RESULTS OF THE NUCLEUS 22-CHANNEL PATIENTS

Patient	Word set	LR (% correct)	CI (% correct)	LR+CI (% correct)
1	Monosyllabic	20	60	72
	Bisyllabic	24	68	84
	Sentence	–	12/15	14/15
2	Monosyllabic	28	44	72
	Bisyllabic	28	92	88
	Sentence	–	13/15	15/15
3	Monosyllabic	16	28	78
	Bisyllabic	20	20	70
	Sentence	–	7/15	12/15
4	Monosyllabic	16	16	52
	Bisyllabic	20	24	56
	Sentence	–	8/15	10/15
5	Monosyllabic	24	74	80
	Bisyllabic	28	72	96
	Sentence	–	15/15	15/15
6	Monosyllabic	60	4	56
	Bisyllabic	–	8	68
	Sentence	–	2/15	9/15
7	Monosyllabic	0	12	44
	Bisyllabic	4	16	48
	Sentence	–	4/15	10/15
8	Monosyllabic	20	44	60
	Bisyllabic	20	56	60
	Sentence	–	12/15	15/15
9	Monosyllabic	20	4	60
	Bisyllabic	24	16	80
	Sentence	–	4/15	12/15

LR = lip reading; CI = cochlear implant, chance score is four per cent, sentences scores out of 15.
Note: Patients 10–12 are congenitally deaf and are in the process of speech rehabilitation.

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TABLE IV
RESULTS OF THE HOUSE/3M CI IN RIGHT EAR AND THE NUCLEUS CI IN LEFT EAR

Type of CI	Word set	LR (% correct)	CI (% correct)	LR+CI (% correct)
House/3M on Rt. ear	Monosyllabic	28	8	44
	Bisyllabic	28	8	80
Nucleus on Lt. ear	Monosyllabic	28	44	72
	Bisyllabic	28	92	88

higher than the score of CI alone. This indicates that the House/3M patients have poor speech recognition but have much lip-reading enhancement.

In Table III, the Nucleus patients are listed consecutively according to their date of implantation. This table shows the open-set word scores of nine Nucleus patients using the CI with and without lip reading. The results of the Nucleus patients with CI vary from 'chance' (four per cent) to excellent (92 per cent). Four of nine patients (patients 1, 2, 5 and 8) have PB scores with CI alone greater than 50 per cent while the rest have PB scores less than 50 per cent. All of them perform everyday sentence tests better than PB word tests. Using the CI with lip-reading, patients 2, 5 and 8 can understand 15 out of 15 on everyday sentence tests and the rest of the patients have scores greater than nine out of 15 on everyday sentence tests. With CI alone, patient 5 can understand 15 out of 15 on everyday sentence tests and five patients (patient 1, 2, 4, 5 and 8) have scores greater than eight out of 15. These data indicated that most of the Nucleus patients except for patient 6 are able to communicate well by hearing alone.

Patient 2 (in Table I) received the House/3M prosthesis in the right ear in 1986 and the Nucleus prosthesis in the left ear in 1996. The results are shown in Table IV. It clearly shows a marked difference between the House/3M CI and the Nucleus CI on auditory performance of speech perception with CI alone. The speech perception scores with CI in the right ear show little ability to recognize speech (eight per cent and eight per cent) while the scores with CI in the left ear are significantly better (44 per cent and 92 per cent).

Discussion

Our experience with cochlear implantation includes four cases of the House/3M CI and 12 cases of the Nucleus CI. Comparing the results of the House/3M with the Nucleus patients and the results of the House/3M CI and Nucleus CI in contralateral ear in the same patient, we find that the House/3M CI provides less benefit in speech perception than the Nucleus CI. These results have been confirmed by many studies (Eyles *et al.*, 1995; Huang *et al.*, 1996).

Single channel devices transmitting low-frequency temporal cues have no spectral selectivity, and all neurons are activated together. Multichannel devices stimulate different areas of the cochlea tonotopically, more spectral information is provided, which enables improved speech recognition (Eyles *et al.*, 1995).

Even though the Nucleus CI system is significantly better than the House/3M CI system, the results on the Nucleus patients vary from chance scores to excellent. Our informal observation of factors contributing to post-operative performance of the Nucleus patients are as follows: overall cognitive function, inherent linguistic ability and hearing impairment since childhood. The post-operative performance of our Nucleus patients has improved over time. We expect the patients implanted less than two years will continue to improve their speech and communicative abilities. The results of three pre-lingually deaf children will be reported later after a period of auditory and speech rehabilitation.

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