SPEECH RECOGNITION ABILITIES IN PROFOUNDLY DEAFENED ADULTS USING THE NUCLEUS 22 CHANNEL COCHLEAR IMPLANT SYSTEM

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Research in the area of cochlear prostheses to restore a
level of hearing sensation to the profoundly deaf has
been ongoing at a number of centers throughout the world
since the 1960's. [3,4,7,8],. Work on a multichannel
cochlear implant that utilizes a speech feature
extraction coding strategy and multi-sited, sequential,
bipolar stimulation to enhance pitch perception began at
the University of Melbourne under the direction of
Professor Graeme Clark in the 1970's. Collaboration with
Nucleus Limited, a multi-national biomedical corporation
from Australia, led to the development of the current
version of the prosthesis. The Nucleus 22 Channel
Cochlear Implant System has been described in detail
elsewhere. [1,5]

As of June 30, 1987, 540 adult patients have been
implanted with the Nucleus device. The patients are
distributed amongst approximately 100 clinics in 12
countries and at least 12 languages are represented.
About 80% of these patients are English speaking, and of
these, 60% are in North America and 20% in Australia.
This paper presents results from these two groups.

Speech recognition scores from 53 North American patients
were obtained on selected subtests of the Iowa Cochlear
Implant Battery.[9] This battery incorporates subtests of
the Minimal Auditory Capabilities Battery[6], in addition
to tests developed at the University of Iowa. The
subtests used were: 1. Four-choice Spondee (a 20 item, 4
alternative, closed-set test), 2. Medial Consonant (a 70
item, 14 alternative, closed-set test, using a
/iCi/context), 3. Iowa Vowel (a 45 item, 9 alternative,
closed-set test, using a /hVd/ context), 4a. NU #6
Monosyllabic Words (a 50 item, open-set test), 4b. NU #6
scored phonetically (a 150 item, open-set test), 5. CID
Everyday Sentences (a 20 sentence, 100 key word, open-set
test). All stimuli were tape recorded using an
unfamiliar male speaker, with a general American dialect.
Tests were administered preoperatively using either high-
gain hearing aids or a tactile device, and were

readministered postoperatively following approximately 3
months of experience with the Nucleus device. All
patients used the speech feature coding strategy that
extracted an estimate of the fundamental frequency and
the first and second formants (F0/F1/F2). Patients
ranged in age from 20 to 75 years with a mean of 48
years. They varied in years of profound deafness from 1
to 69 with a mean of 12 years of profound hearing loss.

Results, presented in Table 1, revealed that as a group,
patients consistently scored higher in the postoperative
condition. For those patients who had both a
preoperative and postoperative score, the paired t-tests
were highly significant for all speech recognition
measures.

Results of speech tracking[2] on 59 patients revealed a
mean word per minute (wpm) difference score of 28.9 wpm
(S.D. 16.9 wpm). The average lipreading only tracking
rate was 21.8 wpm (S.D. 13.9 wpm), while the lipreading
plus speech processor rate was 50.7 wpm (S.D. 20.5 wpm).
A paired t-test showed this difference to be highly
significant (p < .001). In addition, 21 patients
obtained speech tracking scores in the hearing only
condition. The average tracking rate was 25.9 wpm with a
S.D. of 15.1 wpm.

Thirty patients from the University of Melbourne also
were studied. They ranged in age from 19 to 70 years
with a mean of 50 years; the years of profound deafness
ranged from 1 to 40, with a mean of 12 years. An
analysis of factors affecting postoperative patients
performance revealed that patients deafened for less than
15 years and those who could
    discriminate differences in pitch on preoperative
promontory stimulation performed better postoperatively.
Older patients (> 50 years) did not perform significantly
different than younger patients (< 50 years).
Statistical analyses of the North American postoperative
speech recognition data confirmed both trends. These
findings suggest that for appropriately selected
profoundly deafened candidates, the Nucleus cochlear
implant system can provide significant benefit in speech
recognition with and without lipreading.

Table 1. Preoperative and postoperative mean speech recognition scores, standard deviations (S.D.), and paired t-tests for selected subtests of the Iowa Cochlear Implant Battery

Test	#	Preoperative Mean (%) (S.D.%)	Paired Comparison Postoperative Mean (%) (S.D.%)	t-Value
4-Choice Spondee	53	37.0 (23.3)	70.5 (25.1)	8.67*
Medial Consonant	29	8.8 (7.7)	30.9 (18.8)	6.48*
Iowa Vowel	30	14.7 (13.3)	49.7 (22.8)	8.0*
NU #6 Word	53	0.6 (2.0)	6.5 (6.4)	6.65*
NU #6 Phoneme	38	5.7 (9.1)	21.8 (14.5)	6.64*
CID Sentences	49	2.5 (7.5)	20.7 (19.5)	6.42*

* p ≤ 0.001

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