TITLE: RESULTS OF MULTIPLE-ELECTRODE COCHLEAR IMPLANTS IN CHILDREN

AUTHORS: Mecklenburg, D.J., Busby, P.A., Roberts, S.A, Dowell, R.C., Musgrave, G.N., Blamey, P.J., Tong, Y.C., Nienhuys, T., Staller, S.J., and Clark, G.M.

SENIOR AUTHOR: Dianne J. Mecklenburg, Ph.D.
975 Eighth Street
Boulder, CO 80302

RESULTS OF MULTIPLE-ELECTRODE COCHLEAR IMPLANTS IN CHILDREN

Children in Australia and United States of America are now being implanted with the Nucleus 22 electrode intracochlear prosthesis utilizing the F0/F1F2 coding strategy. A total of 32 adolescents (10-17 years) and 24 preadolescents (2-9 years) have been implanted as of 31 August, 1987. No significant post-operative complications were recorded, the speech processors were successfully programmed, and all are users of the device. For the 56 children, the average length of postoperative stimulation time is 2.8 months. Because the majority of children have such short experience with the device we report herein two children from the University of Melbourne (A) and two children from the United States (U) who have been using the Nucleus system for 12 months or more. Child 1A has only 10 electrodes in the cochlea; therefore, the number of channels programmed for the children is 10, 17, 18 and 18, respectively. Child A1 and A2 were deafened by meningitis at 3-3 and 3 years of age, respectively. Child U3 became profoundly deafened from a progressive sensorineural loss at age 11 and Child U4 was deafened by recurrent cochlear hydrops at age 13 years.

In our series of single-subject studies, each child acts as his or her own control. Therefore, different age-appropriate tests are presented for each child. Significant[6] postoperative scores have been obtained for a number of speech perception tests in the audition-alone condition. Significant differences between the vision alone and auditory-visual condition postoperative scores have also been recorded. In addition, marked improvements in speech production and language skills have been observed.

Australian Children

In the auditory-only condition for both children, improvements over postoperative results were obtained for a live-voice, closed-set test of 12 words differing in syllable pattern (3 monosyllables, 3 spondees, 3 trochees and 3 polysyllables). No repeats were given. For Child A1, postoperative categorization as syllable patterns scores were all significantly above chance: 33% (3 mo), 42% (8 mo) and 83% (12 mo) with significant improvement between the 3 and 12 month test periods. For identification, the scores were 17% (3 mo), 0% (8 mo) and 50% (12 mo). For both categorization and identification, the 12 month scores were significantly higher than the 3 and 8 mo. scores. In addition, a significantly above chance score was recorded for the recognition of monosyllabic words[4] in the auditory-alone condition 2 months postoperative (38%). The categorization as syllable pattern scores for Child A2 were significantly above chance at 58% (7 mo), 83% (12 mo) and 75% (20 mo). An increase in the identification scores were also recorded: 33% (7 mo), 25% (12 mo) and 67% (20 mo). Further, the 20 month score of 67% was significantly higher than the preoperative score (17%).

Significant differences between the visual and combined auditory-visual conditions were recorded for the identification of closed-sets of 11 vowels when Child A2 was tested. Postoperative auditory-only and combined scores were obtained at 7 mo (44% and 65%), 13 mo (56% and 98%) and at 20 mo (67% and 89%). Open-set recognition of key words in BKB sentences[2] in the visual (66%) and combined (82%) conditions at 20 mo were also significantly different. No differences between these two conditions were seen preoperatively.

Marked postoperative changes in speech production and language skills were recorded for Child A2 where higher scores for correct consonant production[1] were recorded pre (9%) and post 7 mo (58%), 12 mo (75%) and 19 mo (76.6%). Child A1 demonstrated marked gains in receptive vocabulary[3] postoperatively, with an age-equivalent score (normal hearing) of 2-0 years (1 mo pre) compared to 2-11 years (4 mo, post) and 4-3 years (10 mo post). This rate of postoperative change was greater than that of age-matched normally hearing children.

USA Subjects

Both these children were old enough to be administered subtests of the MAC Battery[5] which has typically been used on adult subjects. For the sake of continuity, both children are reported at the 12 month data collection period in Table 1.

For Child U3, significantly above chance scores were obtained on the 4-choice spondee and final consonant subtests preoperatively in the implanted ear. Postoperatively, it can be seen that significant scores were obtained on all subtests, including the open-set measures of spondee recognition (52%), monosyllabic words (2%), phonemes score (15%) and CID sentences (8%).

Child U4 demonstrated a similar improvement on all subtests, although his scores are considerably higher for open-set: spondee recognition (68%), monosyllabic words (26%); phoneme score (44%), and CID sentences (62%). Preoperatively, significant scores were obtained on the noise/voice and spondee recognition subtests, whereas postoperatively all test results were significantly above chance.

In summary, three of the four children demonstrated open-set speech recognition; all children showed significant improvements between pre- and postoperative evaluations; and all children had increased scores from initial to final postoperative testing.

TABLE 1

MAC BATTERY RESULTS (%) - U3 AND U4

SUBTEST	CHILD U3 PRE	CHILD U3 POST (12MO)	CHILD U4 PRE	CHILD U4 POST (12MO)
PROSODY				
NOISE/VOICE	50	90*	75*	100*
SPONDEE SAME/DIFF	40	100*	55	100*
CLOSED-SET				
4-CHOICE SPONDEE	40*	65*	35	100*
VOWEL	33	47*	28	70*
FINAL CONSONANT	35*	62*	31	90*
INITIAL CONSONANT	31	44*	30	83*
OPEN-SET				
SPONDEE RECOGNITION	0	52*	8*	68*
MONOSYLLABLES	0	2*	0	26*
PHONEME SCORE	7	15*	0	49*
CID	0	8*	0	59*

*SIGNIFICANT $P < 0.05$

REFERENCES

1. Anthony A, Bogle D, Ingram TT, and McIsaac MW (1971) The Edinburgh articulation test. Edinburgh: Churchill Livingston

2. Bench RJ, and Bamford J (eds.) (1979) Speech-hearing tests and the spoken language of hearing-impaired children. London: Academic Press

3. Dunn LM, and Dunn LM (1981) Peabody picture vocabulary test - revised. Circle Pines: American Guidance Service

4. Elliott LL, and Katz DR (1980) Northwestern University children's perception of speech (NU-CHIPS). St. Louis: Auditec

5. Owens E, Kessler DK, Telleen, CC, and Schubert ED (1981 and 1985) The Minimal Auditory Capabilities (MAC) Battery. St. Louis: Auditec

6. Thornton, A.R., and Raffin, M.J. (1978) Speech discrimination scores modeled as a binomial variable. JSHR 21:507-518

Author/s:
Tong, Y. C.; Blamey, P. J.; Dowell, R. C.; Nienhuys, T. G.; Musgrave, G. N.; Mecklenburg, D. J.; Busby, P. A.; Roberts, S. A.; Dowell, R. C.; Musgrave, G. N.; Blamey, P. J.

Title:
Results of multiple-electrode cochlear implants in children

Date:
1987

Citation:
Mecklenburg, D. J., Busby, P. A., Roberts, S. A., Dowell, R. C., Musgrave, G. N., Blamey, P. J., et al. (1987). Results of multiple-electrode cochlear implants in children. In International Cochlear Implant Symposium, Duren.

Persistent Link:
http://hdl.handle.net/11343/26829

File Description:
Results of multiple-electrode cochlear implants in children