

Electrical Auditory Stimulation in the management of Profound Hearing Loss

BY

JOHN C. BALLANTYNE, F.R.C.S.

EDWARD F. EVANS, M.B., PH.D.

AND

ANDREW W. MORRISON, F.R.C.S.

SUPPLEMENT No. 1

The Journal of Laryngology and Otology

OCTOBER 1978

HEADLEY BROTHERS

THE INVICTA PRESS · ASHFORD · KENT

Electrical Auditory Stimulation in the management of Profound Hearing Loss

REPORT TO THE DEPARTMENT OF HEALTH AND SOCIAL SECURITY ON VISITS
IN OCTOBER 1977 TO CENTRES IN THE U.S.A. INVOLVED IN COCHLEAR
IMPLANT PROSTHESES.

BY

JOHN C. BALLANTYNE, F.R.C.S.
(The Royal Free Hospital, London)

EDWARD F. EVANS, M.B., PH.D.
(Department of Communication and Neuroscience, University of Keele)

AND

ANDREW W. MORRISON, F.R.C.S.
(The London Hospital, London)

*The expense of printing this Supplement has been
defrayed by a generous anonymous gift paid through
the T.W.J. Foundation.*

LIST OF CONTENTS

Part 1. Background material and recommendations

	PAGE
1.1. Background material	5
1.1.1. BRIEF HISTORY OF IMPLANTATION	5
1.1.2. RATIONALE OF ARTIFICIAL STIMULATION OF THE AUDITORY SYSTEM	8
1.1.3. THE SIZE OF THE PROBLEM	13
1.1.4. OBJECTIVES OF VISIT	14
1.1.5. ACKNOWLEDGEMENTS	14
1.1.6. GLOSSARY OF TERMS	15
1.2. Summary of observations and recommendations	15
1.2.1. OBSERVATIONS	15
1.2.2. RECOMMENDATIONS	16

Part 2. Centres visited

2.1. Walt Disney Hearing Rehabilitation Center; Los Angeles, California	19
2.1.1. STRATEGY	19
2.1.2. STAFFING AND FACILITIES	20
2.1.3. FUNDING	20
2.1.4. PATIENT SELECTION	21
2.1.5. ELECTRODES	22
2.1.6. TRANSMISSION LINK SYSTEMS	23
2.1.7. SYSTEMS FAILURES	24
2.1.8. SURGICAL CONSIDERATIONS	25
2.1.9. DEMONSTRATION AND EXAMINATION OF IMPLANTED PATIENTS AND ASSESSMENT OF RESPONSES	27
2.1.10. REHABILITATION	35
2.1.11. CURRENT STATUS OF IMPLANT PROGRAMME	36
2.1.12. FUTURE OUTLOOK OF IMPLANT PROGRAMME	37

	PAGE
2.2. Coleman Memorial Laboratory, University of California, San Francisco School of Medicine	38
2.2.1. STRATEGY	38
2.2.2. STAFFING AND FACILITIES	38
2.2.3. FUNDING	39
2.2.4. PATIENT SELECTION	40
2.2.5. ELECTRODES	42
2.2.6. TRANSMISSION LINK SYSTEMS	43
2.2.7. SYSTEMS FAILURES	45
2.2.8. SURGICAL CONSIDERATIONS	45
2.2.9. DEMONSTRATION AND EXAMINATION OF IMPLANTED PATIENTS AND ASSESSMENT OF RESPONSES	47
2.2.10. REHABILITATION	48
2.2.11. ANIMAL EXPERIMENTS	49
2.2.12. CURRENT STATUS OF IMPLANT PROGRAMME	52
2.2.13. FUTURE OUTLOOK OF IMPLANT PROGRAMME	52
2.3. Department of Otolaryngology, Stanford Medical Center, Palo Alto, California	53
2.3.1. STRATEGY	53
2.3.2. STAFFING AND FACILITIES	54
2.3.3. FUNDING	54
2.3.4. PATIENT SELECTION	54
2.3.5. ELECTRODES	55
2.3.6. TRANSMISSION LINK SYSTEMS	55
2.3.7. SYSTEMS FAILURES	57
2.3.8. SURGICAL CONSIDERATIONS	57
2.3.9. DEMONSTRATION AND EXAMINATION OF IMPLANTED PATIENTS AND ASSESSMENT OF RESPONSES	60
2.3.10. REHABILITATION	61
2.3.11. ANIMAL EXPERIMENTS	61
2.3.12. CURRENT STATUS OF IMPLANT PROGRAMME	62
2.3.13. FUTURE OUTLOOK OF IMPLANT PROGRAMME	62
2.4. Weekend Symposium, Stanford University Campus, Lake Tahoe	
2.4.1. SPONSORSHIP BY T.W.J. FOUNDATION	62
2.4.2. INFORMATION ON UTAH PROJECT	63
2.4.3. IMPLANTATION OF CHILDREN	66
2.4.4. CURRENT STATUS OF IMPLANTATION	66
2.4.5. ACKNOWLEDGEMENT TO DR. MANSFIELD SMITH	67

	PAGE
2.5. Visit to National Institutes of Health, Bethesda, Maryland	67
2.5.1. MEETING WITH DR. DAVID G. HANSON	67
2.5.2. MEETING WITH DR. KARL FRANK	69
2.5.3. MEETING WITH DR. TERRY HAMBRECHT	69
2.5.4. VISIT BY DR. E. F. EVANS TO THE LABORATORY OF NEURAL CONTROL, NATIONAL INSTITUTE OF NEURO- LOGICAL AND COMMUNICATIVE DISORDERS AND STROKE	70

Part 3. Other related visits

3.1. Visit by Dr. E. F. Evans to Department of Otolaryngology, University of Washington, Seattle	71
3.1.1. N.I.H. GRANT	71
3.1.2. ELECTRODES AND STIMULATION	71
3.1.3. BEHAVIOURAL DATA	71
3.1.4. HISTOLOGICAL DATA	72
3.1.5. PHYSIOLOGICAL DATA	72
3.2. Visit by Dr. E. F. Evans to Department of Otolaryngology, University of Oregon, Portland	73
3.2.1. SUMMARY OF RESEARCH	73

Part 4. Collective information summary with comments

4.1. Strategy	75
4.2. Staffing and facilities	76
4.3. Patient selection and pre-operative preparation	77
4.4. Electrodes	80
4.5. Transmission link systems	82
4.6. Systems failures	84
4.7. Surgical considerations	84
4.8. Rehabilitation	88

Part 5. Detailed observations and recommendations

5.1. Observations	91
5.1.1. IMPLANT MATERIALS	91
5.1.2. THE EFFICACY OF SINGLE CHANNEL IMPLANTS	91
5.1.3. THE EVALUATION OF SURVIVING NEURONAL POPULATIONS	92
5.1.4. SAFETY OF COCHLEAR IMPLANTATION AND STIMU- LATION	92
5.1.5. MULTIPLE CHANNEL IMPLANTS	93
5.1.6. CURRENT STATUS OF IMPLANTATION PROGRAMME	93

	PAGE
5.2. Recommendations	94
5.2.1. INITIAL TRIALS OF THE EFFECTIVENESS OF SINGLE CHANNEL STIMULATION	94
5.2.2. REHABILITATION OF PATIENTS WITH PROFOUND/TOTAL HEARING LOSS BY SINGLE CHANNEL COCHLEAR IMPLANTS	96
5.2.3. CONTINUATION AND ENCOURAGEMENT OF BASIC AND APPLIED RESEARCH RELEVANT TO LONG-TERM SINGLE AND MULTI-CHANNEL COCHLEAR IMPLANTATION	99

Part 6. Tables

6.1. Aetiology of patients permanently implanted in the U.S.A.	101
6.2. Current status of use of permanently implanted patients in the U.S.A.	101

Part 7. Appendices

7.1. Summary of questions asked of each cochlear implant team carrying out clinical work	103
7.2. The place of transtympanic electrocochleography and promontory stimulation in patient selection	103
7.3. Brief summary of Pittsburgh study	104
7.4. Walt Disney hearing rehabilitation research centre rehabilitation programme	105
7.5. Ethical guidelines adopted at the first international conference on electrical stimulation of the acoustic nerve for profound sensorineural deafness in man	107
7.6. Participants in weekend symposium, Lake Tahoe	107
7.7. Third international course of Otoneurosurgery: additional information with comments	108

Part 8. References