The University of Melbourne -
Nucleus Multi-Electrode Cochlear Implant

G.M. Clark et al.

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Nucleus Multi-Electrode
Cochlear Implant

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Preface

Cochlear prostheses are one of the first neuroprosthetic devices to be used widely on a regular clinical basis. They have resulted from multi-disciplinary research in physiology, biology, surgery, engineering, psychophysics, speech science, and other related fields. There can be few developments that have required such a diverse input. Cochlear prostheses have contributed to the scientific basis underlying the specialty of oto-rhino-laryngology. In the future they should also make major contributions to the practice of audiology, education of the deaf and speech pathology. Although a new era in the management of deafness has emerged there is a great need for continuing research in this field to improve the performance of devices so that as many patients as possible may benefit.

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Foreword

The first reports of electric stimulation of the acoustic nerve in man go back to the late 1930s. It took another 20 years until 1957 the French group of Djourno, Eyrries and Vallancien were able to publish their results of successful electric stimulation of the cochlear nerve in 2 human subjects. They implanted microinduction coils which stimulated the nerve distance. However, technical failures discouraged this group of pioneers to continue their research. Seven years later (1964) B. Simmons, Mongeon, Lewis and Huntington from Stanford University Medical School reported their results of direct electric stimulation of the cochlear nerve by means of a multiple bipolar electrode system, implanted in a deaf human subject. Also this research group abandoned their project because the patient's benefit from the cochlear implant was not very promising in the long run. Moreover, experimental data were lacking which indicated that electrodes could be implanted into animal or human cochleae without causing long-term secondary degeneration of the afferent nerve fibers.

In 1968 Michelson was able to give substantial evidence from his animal studies that intracochelear electrodes could be maintained safely and would be functioning for long periods of time. W. House and Urban
then began to develop more sophisticated cochlear implant systems. Their extensive studies on a single subject, who had been successfully implanted, guided further engineering development and resulted in the first stimulator package which could be worn by the patient without impeding his professional or social activities. This was the first breakthrough from the merely experimental period into the clinical application period of cochlear implants. In 1973 the House group developed a preoperative diagnostic test battery for selection of patients and a postoperative rehabilitation program. In the same year the first international conference on electric stimulation of the acoustic nerve as a treatment for profound sensorineural deafness in man was held in San Francisco under the presidency of the late F. Sooy, at that time chancellor of the University of California.

Foreword X

All over the world research groups were forming, representing multidisciplinary teams including audiologists, bioengineers, speech and hearing therapists, psychologists, social workers and last but not least otologists, who took the responsibility for selecting, operating and guiding the implanted patients. Technical progress was rather rapid: Not only intra- but also extracochlear implants were developed; single-channel electrodes were replaced by multichannel devices, speech processors became smaller and more efficient. This technical evolution was only feasible by means of progress in electronic engineering on the one side and an intensive neurosensory research on the other. At the University of Melbourne G. Clark started in 1967 his physiological research on electric stimulation of the cochlear nerve in animals. In 1970 he published a paper on the neurophysiological assessment of the surgical treatment of perceptive deafness, in 1973 he reported the results of his experimental studies in 4 cats: A Hearing Prothesis for Severe Perceptive Deafness. In 1978 a multichannel prototype receiver had been fabricated and the preliminary safety studies completed. The first two implants were carried out in 1978 and 1979 and the results were encouraging. In close cooperation with the Australian biotechnical firm Nucleus Ltd., with a substantial support by the Australian government, Professor G. Clark and his research group from Melbourne University developed a multichannel cochlear implant providing spectral information in addition to temporal and intensity cues, thus allowing profoundly deaf postlingual adults not only to perceive the complex noise of their acoustic environment but also to recognize words with and even without visual cues. The development of this new multichannel cochlear implant may be
considered a second breakthrough, closing the period of clinical studies and opening a new area of practical application and clinical testing of cochlear implants. The present monograph provides detailed information about the physiology and psychophysics of electric stimulation of the auditory nerve, about biological aspects (e.g. biocompatibility), the engineering of the receiver-stimulator and speech processor, the selection of patients, surgery, psychophysics and speech perception in postlingually deaf adults. This monograph also gives evidence of the important scientific work accomplished by the multidisciplinary Australian research group which must be considered an important contribution to the rehabilitation of the deaf.

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