The Long Term Outcome of Cochlear Implantation on Speech Perception and Quality of Life

Thesis

Submitted for Partial Fulfillment of Master Degree in Audiology

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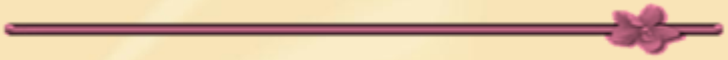
Asmaa El Saied

Dedication

I would like to dedicate this thesis

to My parents, Husband, Brothers and Sisters

for Their endless love support and continuous care.



With deep thanks

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List of Abbreviations

Abb.	Full term
AAA	American Academy of Audiology
ABR	Auditory evoked response electrically evoked Auditory evoked response
ACC	Acoustic change complex
CAEP	Cortical auditory evoked potentials
CI	Cochlear implant
CIs	Cochlear implants
CI-HRQOL	Cochlear implant health related quality of life
CV	Consonant vowel
dB	Decibel hearing level
E-ABR	Electrically middle latency evoked response
EDR	Electrical dynamic range
E-LLAR	Electrically late latency auditory response
E-MLR	Electrically middle latency response
GBI	Glasgow benefit inventory
HRQOL	Health related quality of life
Hz	Hertz
IDEA	Individuals with disability education act
IDR	Input dynamic range
MMN	Mismatch negativity
NCIQ	Nijmegen cochlear implant questionnaire
PB	Phonetically balanced
PBKG	Phonetically balanced kindergarten
PTA	Pure tone audiometry
PVECIQ	Parents' views and experiences with pediatric cochlear implant questionnaire

Abb.	Full term
QoL	Quality of life
S/N	Signal to noise
SES	Socioeconomic status
SIR	Speech intelligibility rating
SNHL	Sensorineural hearing loss
UNC	University of North Carolina
US	United States
VC	Visual cues
WHO	World Health Organization
WIPI	Word intelligibility by picture identification

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Abstract

Background: In spite of the crucial rule of studying long-term effect of CI, few researches had been conducted to evaluate it. **Objective:** To evaluate the long term effect of implantation on speech perception and to assess the quality of life and communication status in cochlear implant users. **Methods:** 40 cochlear implant users (children & adults) were recruited from the database of cochlear implant recipients (for at least 5 years of CI use), besides 50 normal hearing subjects as control for different speech tests used. An Arabic version of **Nijmegen Cochlear Implant Questionnaire (NCIQ)** for adults and **Parents' views and experiences with pediatric cochlear implant questionnaire (PVECIQ)** for children' Parents were translated and applied in the study. All CI users were subjected to aided sound field and Arabic speech perception test battery (monosyllabic words and sentences both in quiet and noise situations) for adults and children.
Results: Adults NCIQ: The best scores achievement were found at physical functioning domain, while the worst scores were found at psychological functioning domain. Some explanations appeared by an open interview. **Audiological evaluation**: All adults except one had aided PTA within the LTASS with comparable speech perception scores to normal hearing subjects in quiet. All adults needed a positive S/N to reach 50% discrimination without visual cues and almost half of them could perform the test with S/N zero or -5 with visual cues (Normal adults could reach 100% discrimination at **-10** S/N ratio). No statistically significant difference between average aided PTA threshold and speech perception scores with any subdomain or total of NCIQ. **Children PVECIQ:** The best scores achievement were found at process of implantation & general function domains, while the worst scores were found at effect of implantation & communication domains. **Audiological evaluation**: Although, almost all children had aided PTA within the LTASS, there was a wide range of variability of the benefits provided by the CI regarding the development listening skills. There were children those who could reach high scores & on the other hand others didn't acquire any spoken language & unfortunately shifted to sign language. There was statistically significant difference between General function domain with Sentence test "2" (in quiet) without visual cues and support the child domain with Sentence test "1" (in quiet) without and with visual cues. **Conclusions**: Audiological evaluation alone are likely insufficient to fully examine the benefits or limitations of cochlear implantation.

Key Words: Cochlear implants, speech perception, quality of life.

Introduction and Rationale

Hearing impairment is the most prevalent disabling condition globally. According to the WHO statistics, there were 120 million individuals with a disabling hearing loss globally in 1995. By 2005, this figure had doubled to 278 million and during 2011; the number has increased to 360 million people (over 5% of the world's population). Based on WHO 2018 estimates, there are 466 million persons in the world with disabling hearing loss. Unless action is taken, it is likely that the number of people with disabling hearing loss will grow over the coming years. Projections show that the number could rise to 630 million by 2030 and may be over 900 million in 2050 **(WHO, 1980; 2010; 2018)**.

Disabling hearing impairment has devastating consequences for interpersonal communication, psychosocial well-being, quality of life and economic independence **(Kotby et al., 2008)**. If it develops in the young, such impairment impedes speech and language development and sets the affected children on a trajectory of limited educational and vocational attainment **(Schroeder et al., 2006; Venail et al., 2010)**.

Children with hearing impairment may also be at increased risk of physical, social, emotional and sexual abuse and even murder **(Jones et al., 2012)**. In adulthood, disabling hearing impairment can lead to embarrassment, loneliness, social isolation and stigmatization, prejudice, abuse, psychiatric disturbance, depression, difficulties in relationships with partners and children, restricted career choices, occupational stress and relatively low earnings **(Ruben et al., 2000; Shield, 2006)**.

Audiological rehabilitation is the process of minimizing any disability which an individual experiences as a result of hearing loss together with improving their communication ability, as well as improvement of the quality of life **(Stephens, 1987)**. Cochlear implantation is currently a well-established method for restoring hearing to people with profound hearing loss **(Blamey et al., 2013; Holden et al., 2013)**.Cochlear implants have been dubbed "the most successful of all neural prostheses" helping to partly restore hearing in more than 300 000 people around the world **(Clark et al., 2013)**. There is no age limit for implantation and even additional disabilities are no longer contraindication for CI **(Sampaio et al., 2011; Cosetti et al., 2015)**.

Audibility of all speech frequencies is essentials in acquisition for speech and to develop age appropriate language development and literacy skills**.** Several observational studies have shown that early auditory intervention with a CI and prompt enrollment in rehabilitation and education program enable hearing impaired children to gain good quality access to auditory stimulation, achieve age-appropriate spoken language levels and eventually provide opportunities for normal social and academic development. This is the aim of amplification as clarified by the American Academy of Audiology **(AAA, 2013)**.

In infants and toddlers with prelingual or congenital SNHL, more than two decades of accumulated data show that many of these children can develop and continue to maintain good speech and language abilities with the use of a CI, even in the long term **(Ruffin et al., 2013).** Speech recognition performance in children with cochlear implants has continued to improve with advances in technology and the implantation of younger children **(Geers et al., 2003)**. In children with prelingually hearing loss, the average results continuously improved over the 4-year period. Individuals with < 5 years of deafness had a faster rate of

recovery of speech perception than those who had been deaf for > 5 years **(Johnson et al., 2010)**.

Cochlear implantation affects not only hearing abilities, speech perception and speech production, it also has an outstanding impact on the social life, activities and self-esteem of each patient. Various questionnaires have been developed to assess the quality of life in such patients **(Loeffler et al., 2010)**.

The Nijmegen Cochlear Implant Questionnaire (NCIQ) has become a standard questionnaire in assessing the quality of life (QoL) of patients with cochlear implants, has been validated and shown to be reliable and sensitive to clinical changes. The NCIQ provides a sensitive and reliable instrument to rate the quality of life in patients provided with a cochlear implant. The questionnaire is able to detect a wide variety of aspects within the QoL. In most of the reports significant improvements in the NCIQ scores were observed in total scores as well as in all subdomains **(Damen et al., 2007; Hirschfelder et al., 2008)**.

The Parents' views and experiences with pediatric cochlear implant questionnaire (PVECIQ) can be used to describe how pediatric cochlear implants affect the children’s lives according to their parents’ perceptions as