Comparison between outcomes of hearing aids use and cochlear implants in patients with severe to profound hearing loss

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Menna Allah Essam

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Abbreviations

ABIs	Auditory Brainstem Implants
A/D	Analog to Digital
BAHA	Bone Anchored Hearing Aid
BTE	Behind The Ear
CHL	Conductive Hearing Loss
CI	Cochlear Implantation
CIC	Completely In The Canal
D/A	Digital to Analog
dB	Decible
FDA	Food and Drug Administration
HAs	Hearing Aids
HL	Hearing Loss
HSM	Hochmair, Schultz and Moser sentence test
Hz	Hertz
ITC	In The Canal
ITE	In The Ear
MEIs	Middle Ear Implants
PTA	Pure Tone Average
RI-TLS	Rosetti Infant-Toddler Language Scale
SNHL	Sensorineural Hearing Loss
SNR	Signal-to-Noise Ratio
WHO	World Health Organization
WISC	Wechsler Intelligence Scale for Children

INTRODUCTION

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Childhood permanent hearing loss has lifelong consequences for both children and their families. Its early detection, together with appropriate intervention, is critical to speech, language and cognitive development in hearing- impaired children. Hearing dysfunctions in children can be classified by type, degree, configuration, time of onset, etiology, and finally, consequences on speech development. More briefly, they can be classified according to the affected part of the auditory system into: conductive, sensorineural, mixed and central type of hearing loss **(Paludetti et al., 2012)**.

Deafness and hearing loss have been researched for centuries, and attitudes towards hearing loss and early intervention have changed dramatically over time. In a few generations, treatment of children with severe to profound hearing loss has changed from isolated, institutional environments to mainstreamed public education **(Tomblin et al., 1999).**

Therapy remains the major challenge in pediatric management of sensorineural hearing loss, amplification in the form of hearing aids or cochlear implants is the mainstay for the treatment of permanent childhood hearing impairment in most cases **{(Hicks and Wright, 1991)** and **(De et al., 2008)}.**

Conventional hearing aids are indicated in children with severe hearing loss inducing delayed language or articulation disorders **{(Palmer et al., 2005)** and **(Fitzpatrick et al., 2010)}.**

Also, using hearing aids improved adults' health-related quality of life by reducing the psychological, social and emotional effects of the hearing loss **(Chisolm et al., 2007).**

Cochlear implants are considered a real revolution in the treatment of severe-to-profound bilateral sensorineural hearing loss, being the most effective way to correct a severe acoustic damage not amendable with conventional hearing aids **(Niparko et al., 2010).**

The functional results after cochlear implantation showed progress in all patients compared with their preoperative situations. They all showed a clear benefit from the implantation **(Kiefer et al., 1998).**

Auditory brainstem implants should be restricted to patients with profound hearing loss or even total hearing loss due to a non-functional auditory nerve who are not cochlear implantation candidates and have no other options for hearing rehabilitation **(Kozin and Lee, 2013).**

In recent years, many studies were published comparing the hearing results obtained in patients with severe to profound hearing loss that used hearing aids or cochlear implants. Most patients with hearing loss, including severe loss, benefit from the use of hearing aid. In cases where the severity of the deficiency renders hearing aid incapable of providing appropriate acoustic information, it is believed that cochlear implantation produces the best results in the rehabilitation of children with hearing loss, since they require sufficient cochlear reserve for sound detection which is not present with such severity **(Mildner et al., 2006).**

cochlear implantation directly stimulate the cochlear nerve fibers and enable better perception and discrimination of speech, sounds of the environment, and alerts **(Van den Borne et al., 1998).**

A great deal of research has been conducted comparing language and communication development in children who use hearing aids to children who have cochlear implantation. A review of this literature indicates, however, that the focus has been on demonstrating that

cochlear implants users demonstrate greater gains in language and communication over those with similar levels of hearing loss who use hearing aids **{(Peng et al., 2004), (Paatcsh et al., 2004)** and **(Cleary et al., 2005)}.**

People with severe-to-profound hearing losses have more options for hearing better than ever before. As candidacy criteria for cochlear implantation has relaxed to allow individuals with more residual hearing to be implanted, it has become common to combine acoustic stimulation via hearing aid with electrical stimulation via the cochlear implantation. The most common combination currently is the bimodal fitting, where the user wears a hearing aid on the contralateral ear from the implant. Bimodal fitting has been shown to yield binaural hearing benefits over time **(Nesgaard Pedersen and Kirkwood, 2014).**

AIM OF THE WORK

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The aim of this work is to review the literature regarding the outcomes of using conventional hearing aids versus cochlear implants in patients with severe to profound hearing loss; in order to better understand the differences and thus helping those patients to make the proper choice.

REVIEW OF LITERATURE

Hearing loss

Hearing is one of the most important senses for human beings. It is due to hearing that humans communicate, because most communication is achieved through sound patterns. The impact of hearing deprivation in an individual's life is huge because it not only affects one's ability to properly comprehend auditory information, but also, predominantly, how to relate to one's environment and culture. Furthermore, this sensory deprivation causes biological, psychological, and social consequences **(Kozlowski et al., 2014)**.

Definition of hearing loss:

Hearing loss (HL) refers to a condition in which the subject is unable to detect or distinguish the range of sounds normally available to the human ear **(Justice, 2006),** while Deafness is the complete loss of hearing and the child is unable to respond to auditory stimuli even with optimal hearing aid amplification **{(Sataloff and Sataloff, 1993)** and **(Elzouki et al., 2012)}.**

HL exists when there is diminished sensitivity to the sounds normally heard. The terms hearing impairment or hard of hearing are usually reserved for people who have relative insensitivity to sound in the speech frequencies. The severity of HL is categorized according to the increase in volume above the usual level necessary before the listener can detect it **(Elzouki et al., 2012).**

Classification of hearing loss:

HL is categorized by its type, its severity, and the age of onset (before or after language is acquired). Furthermore, a hearing loss may

exist in only one ear (unilateral) or in both ears (bilateral**) (Elzouki et al., 2012).**

HL is diagnosed by audiologists and according to **(Kaplan et al., 1993)** its degree is classified into:

1- Slight hearing impairment >16-25 decibels (dB).

2- Mild HL >26-40 dB.

3- Moderate HL >41-55dB.

4- Moderately severe >56-70 dB.

5- Severe HL >71-90 dB.

6- Profound HL greater than 90 dB.

The main types of HL - according to which part of the auditory system is affected - are: conductive HL, sensorineural HL, a combination of the two called mixed HL and central type of HL **(Kral and O'Donoghue, 2010).**

Conductive hearing loss (CHL):

CHL is present when the sound is not reaching the inner ear; the cochlea. This can be due to external ear canal malformation, dysfunction of the eardrum or malfunction of the bones of the middle ear. The ear drum may show defects from small to total resulting in HL of different degree. Scar tissue after ear infections may also make the ear drum dysfunction as well as when it is retracted and adherent to the medial part of the middle ear. Dysfunction of the three small bones of the middle ear – malleus, incus, and stapes – may cause CHL. The mobility of the ossicles may be impaired for different reasons and disruption of the ossicular chain due to trauma, infection or anchylosis may also cause HL.