

Contents

Subjects	Page
List of abbreviations.....	II
List of Figures	IV
List of Tables.....	VI
• Introduction and Rationale	1
• Aims of the Work	4
• Review of Literature	
◆ Chapter (1): Frequency lowering technology.....	5
◆ Chapter (2): Hearing aids assessment in children.....	36
◆ Chapter (3): Auditory evoked potentials as a measure for hearing aid performance in hearing aid users	49
• Materials and Methods	74
• Results	84
• Discussion	116
• Conclusions	129
• Recommendations	130
• Summary	131
• References	135
• Arabic Summary	

List of Abbreviations

AAA	: American Academy of Audiology.
ABR	: Auditory brainstem response.
AEP	: Auditory evoked potential.
ASFT	: Aided sound field thresholds.
ASSR	: Auditory steady state response.
CAEP	: Cortical auditory evoked potential.
CNC	: Consonant nucleus consonant.
DAI	: Direct audio input.
dBHL	: Decibels hearing level.
dB SPL	: Decibel sound pressure level.
DCB	: Dynamic consonant boost.
Has	: Hearing aids.
HI	: Hearing impaired.
ISI	: Interstimulus interval.
LFT	: Linear frequency transposition.
LTASS	: Long Term Average Speech Spectrum.
MLR	: Middle latency response.
MMN	: Mismatch negativity.
NFC	: Nonlinear frequency compression.

 *List of Abbreviations*

NH	: Normal hearing.
PBKG	: Phonetically balanced words list.
PTA	: Pure tone audiometry.
RECDs	: Real ear to coupler differences.
REMs	: Real Ear Measures.
RMS	: Root-mean-square.
SDT	: Speech detection threshold.
SNHL	: Sensorineural hearing loss.
SNR	: Signal to noise ratio.
SRT	: Speech recognition threshold.
UCL	: Uncomfortable loudness level.
WIPI	: Word intelligibility by picture identification.
WRS	: Word recognition scores.

List of Figures

No.	Figure	Page
<u>1</u>	Flow chart illustrating the effect of SNHL on children.	6
<u>2</u>	A spectrogram of the nonsense utterance /a-s-a-sh-a/. The two consonants /s/ and /sh/ are dominated by intense high-frequency components.	8
<u>3</u>	Group of figures showing mechanism of action of LFT.	21
<u>4</u>	Two spectrograms: the first, was recorded without LFT and the second, was recorded with LFT. Each recording is of the same speech stimulus containing a word-medial and word-final 'SH' or /ʃ/.	24
<u>5</u>	Mechanism of action of spectral envelope warping.	35
<u>6</u>	An Audioscan Verifit screen capture of aided verification results the LTASS for average level speech (5000 Hz) without Sound Recover and with Sound Recover.	42
<u>7</u>	Mean of PTA thresholds in right & left ear in the study group at different frequencies.	87
<u>8</u>	Mean of binaural aided PT thresholds with NFC enabled and disabled.	91
<u>9,a</u>	P1 CAEP using da stimulus in a normal 6 years old boy.	94

 *List of Figures*

<u>No.</u>	<u>Figure</u>	<u>Page</u>
<u>9,b</u>	PTA with binaural aided thresholds using Naida HA in one of study group children	95
<u>9,c</u>	P1 CAEP using da stimulus with NFC disabled in one of study group children	96
<u>9,d</u>	P1 CAEP using da stimulus with NFC enabled in one of study group children	96
<u>10,a</u>	P1,N2 waveform pattern	99
<u>10,b</u>	P1,N1,P2,N2 waveform pattern	99
<u>11,a</u>	PTA with binaural aided thresholds using Naida HA in one of study group children	101
<u>11,b</u>	P1 CAEP using da stimulus with NFC disabled in one of study group children	102
<u>11,c</u>	P1 CAEP using da stimulus with NFC enabled in one of study group children	102
<u>11,d</u>	P1 CAEP using ga stimulus with NFC disabled in one of study group children	103
<u>11,e</u>	P1 CAEP using ga stimulus with NFC enabled in one of study group children	103

List of Tables

<u>No.</u>	<u>Table</u>	<u>Page</u>
<u>1</u>	Mean, standard deviation (SD) and range of age, age of onset and duration of hearing loss in years in the study group children.	85
<u>2</u>	Mean, S.D. and range of PTA thresholds in right and left ears in the study group.	86
<u>3</u>	Number (N.) and percent (%) of ears with absent PTA thresholds at the tested frequencies.	88
<u>4</u>	Mean, SD and range of SRT and SDT in the study group.	88
<u>5</u>	Number (N.) and percent (%) of children with aided pure tone thresholds at 2 & 4 kHz with NFC enabled or disabled.	89
<u>6</u>	Mean, SD, t test and p value of aided pure tone thresholds with nonlinear frequency compression (NFC) enabled or disabled.	90
<u>7</u>	Mean, SD and range, t and p value of SRT & WRS % in study group with NFC enabled or disabled.	92
<u>8</u>	Number (N.) and Percent (%) of p1 CAEP detectability in the control and study groups using da stimulus with NFC enabled and disabled.	93
<u>9</u>	Number (N.) and Percent (%) and Fisher exact test of p1 CAEP detectability in the control and study groups using ga stimulus with NFC enabled and disabled.	97

 *List of Tables*

<u>No.</u>	<u>Table</u>	<u>Page</u>
<u>10</u>	Waveform pattern of CAEP in the study with NFC enabled and the control group using da stimulus.	98
<u>11</u>	Waveform pattern of CAEP in the study with NFC enabled and the control group using ga stimulus.	98
<u>12</u>	Detectability of p1 CAEP in NFC enabled and disabled using da and ga at different intensities.	100
<u>13</u>	Median of latency at intensity 75 using ga and da stimuli.	104
<u>14</u>	Mean, SD, t and p values of p1 latency using both stimuli with NFC enabled and disabled.	105
<u>15</u>	Mean, SD, range, t and p value of p1 amplitude using both stimuli with NLFC enabled and disabled.	106
<u>16</u>	Correlation between presence of p1 at intensity 75 dB SPL to age of child, duration of hearing loss and duration of hearing aid use.	107
<u>17</u>	Correlation between presence of p1 using NFC with SRT, SDT and AIDED WRS % using NFC.	108
<u>18</u>	Correlation between latency of p1 at intensity 75 to discrimination score using NFC enabled.	109
<u>19</u>	Mean, SD and range of age, age of onset & duration of HL, duration of NFC use of the 2nd subgroup (previous NFC users).	110

 *List of Tables*

<u>No.</u>	<u>Table</u>	<u>Page</u>
<u>20</u>	Comparison of aided PTA thresholds and WRS% between both subgroups using student t test while NFC is enabled.	111
<u>21</u>	Comparison between both subgroups as regards percent detectability of p1 using da and ga stimulus with NFC enabled at intensity 75 dB SPL.	112
<u>22</u>	Comparison between both subgroups as regards p1 latency using da and ga stimulus at intensity 75 with NFC enabled using student t test.	113
<u>23</u>	Comparison between both subgroups as regards p1 amplitude using da and ga stimulus at intensity 75 with NFC enabled using student t test.	114

**Aided Cortical Evoked Potentials
in Children with Frequency
Compression Hearing Aid
Technology**

Thesis

Submitted for the Partial Fulfillment of Master
Degree in **Audiology**

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استجابة الجهود المثارة سمعياً من منطقة قشرة المخ فى الاطفال فى وجود معينة السمع ذات تكنولوجيا ضغط التردد

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالَ مَوْلَا

سَبَّحَانَكَ لَا أَعْلَمُ لَنَا
إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْعَظِيمُ

صدق الله العظيم

سورة البقرة الآية: ٣٢

Introduction and Rationale

Audibility of sounds across all speech frequencies plays an important role in acquisition of speech for hearing-impaired subjects. High frequency information is important for the perception of many speech and environmental sounds. Moreover, perception of high frequency sounds is important for children language development as well as improving speech understanding especially in noisy listening environments (**Plyler et al., 2006**). It provides listeners with important linguistic information (**Stelmachowicz et al., 2004**).

Higher speech intelligibility is the principle target in hearing aid amplification. Most of conventional hearing aid (HA) technologies don't provide adequate amplification in the high frequencies. This in turn has specific detrimental effects on speech sound recognition in children and delays the speech production of high frequency sounds (**Stelmachowicz et al., 2004**). To solve this problem, frequency-lowering techniques have been proposed, whereby the frequency of the sounds from the disabled region is shifted into more sensitive frequency regions, (**Miller et al., 2003**). The frequency-lowering technology includes two classes: frequency transposition and frequency compression.

The nonlinear frequency compression (NFC) splits the incoming hearing aid signal into 2 channels. The high-frequency channel is compressed into a narrower bandwidth. These results in sound being lowered in frequency within the high-frequency channel only with an adjustable cut-off frequency between the high and low bands and adjustable frequency compression ratio in the high band (**Simpson et al., 2005**).

Glista et al. (2009) and Wolfe et al. (2011) investigated the role of nonlinear frequency compression in older children with steeply sloping high frequency hearing loss. They reported improved speech recognition and production of some high frequency sounds with no significant changes on low frequency sounds in average.

Validation of hearing aids benefit includes subjective tests, objective tests & speech tests during amplification situation (**Katz, 2009**). As enhancement of speech perception is the main issue in HA fitting, the aided speech tests constitute the main part of the HA function validation process .Assessment of aided speech skills could be a difficult task in young children and infants. Accordingly, there is more need for objective tests such as the aided evoked potentials.

The cortical auditory evoked potentials (CAEPs) represent the summed neural activity in the auditory cortex

in response to sounds (**Van Dun et al., 2012**). The peaks of the complex are thought to reflect neural activation of the central auditory system in response to the spectral & temporal properties of a given stimulus (**Tremblay et al., 2003**). Aided CAEPs measured before and after a given auditory training program may reflect the efficiency of the program and confirm the plasticity of the auditory pathways (**Koravand et al., 2012**). As reported by **Rance et al. (2002)** and **Golding et al. (2007)**, there is a significant relation between the presence of cortical responses & speech perception scores and functional measures of hearing ability using hearing aids.

The CAEPs response detection for 4 KHz tone improved when using frequency compression hearing aid technology (**glista et al., 2012**).

Zhang et al. (2012) results showed that there was an increase in number of cortical responses elicited by speech sounds at 55 dB SPL when frequency compression was used in hearing aids.

This study was designed to explore the pattern of auditory processing of syllables when using nonlinear frequency compression through speech p1 cortical evoked potentials in children with sensorineural hearing loss.