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Quality of sound in post-lingual cochlear implant users

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Abstract
To profile the quality of sound in post - lingual Cochlear Implantees.20 random post - lingual Cochlear Implantees who were implanted at MERF - ISH (P) Ltd. were selected and participated in the study. The questionnaire was administered to the 20 participants who were native Tamil speakers and who were able to read Tamil were selected for the study. Adult Post - lingual CI users with minimum of 6 month of implant age were selected for the study. Participants were unilateral, bilateral Implantees. In relevance to experience, regular usage (minimum of 8 hours per day) of cochlear implant was considered. The translation of this questionnaire was done on the basis of guidelines given by World Health Organization (process of translation and adaptation of instruments, 2008). Forward translation, Expert panel back translation, Pre testing and cognitive interviewing Final version. Results showed that there was no correlation between the total HISQUI scores and age at implantation. Correspondingly in original HISQUI19 German - language validation study they found only a slight and not significant difference between the scores of subjects younger than 60 years at implantation and those older than 60 years, though a stratification was not done in the present study. Based on the results of this study we may conclude that the HISQUI19 Tamil version is a valid measure of self - perceived sound quality in everyday listening situations in adult CI users with post - lingual hearing loss. It is also a useful instrument for evaluating the subjective outcomes of cochlear implantation and helpful for improving rehabilitation. Keywords: Cochlear Implantees, Outcomes, HSIQUI, Post lingual.

Keywords: Post-lingual, implant users, cochlear

Introduction
The treatment of hearing loss depends on the type of loss and cause. Medical, surgical, and amplification are the three treatment modalities. Medical therapy in the form of oral and ototopical antibiotics and steroids are used for infectious and systemic etiologies. The surgical treatment of hearing loss falls into reparative procedures as a result of infectious (middle ear pathologies) or traumatic etiologies, and restorative procedure to rehabilitate hearing loss that cannot be treated with conventional amplification. The bone-anchored hearing aid (BAHA) is a device that can be used to restore a conductive loss that cannot be treated with conventional amplification or unilateral profound hearing loss. Amplification and assistive listening devices are the mainstay for treating hearing loss. Cochlear implants are sophisticated devices used to rehabilitate those with bilateral profound sensory hearing loss.

The cochlear implant bypasses a non-functional cochlea and directly stimulates the cochlear nerve. This device is approved for adults and children 1 year or older. Children identified with profound hearing loss and those with severe to profound loss that do not reach speech and communication milestones with amplification should be implanted as soon as possible. A cochlear implant enhances speech perception and speech production in adults and improves hearing in all aspects (Lenarz, 1998) [19]. The auditory brainstem implant may be used in patients without an intact cochlear nerve. An auditory brainstem implant directly stimulates Hearing Loss the cochlear nucleus and most patients have improved sound awareness and enhanced lip reading.

It is known that person with normal, or near-normal hearing before the HI sets in that is post-lingual individual, tend to have better performance when compared to those who are born deaf. Hearing input associated with the neural plasticity and the linguistic skills developed prior to the HI can be useful in helping an individual to interpret the auditory information provided by the CI.

Exchanging information with others is one of the most important aspect in everyday life, it can be seriously impaired with individuals with hearing loss. These difficulties with communication could lead to a perceived reduction in quality of life. As life expectancy increases and older adults are living longer, an increasing number of individuals will be forced to endure hearing loss during their senior years.

Though CI is effective technology, it also has limitations in various aspects, for example in broader terms like in physical, psychological and social functioning situations. The most frequent complaint is the difficulty for the user to understand speech in the presence of background noise. The performance of speech perception in cochlear implant users is damaged when the competitive noise is introduced, the index of speech recognition is better when the speech is presented ipsi laterally, and it's consequently worse when presented contra laterally to the cochlear implant, and there are more damages in the speech intelligibility when there is only mono aural input. Thiago, Fernandes & Amorim 2009) [16].

Evaluating the performance of the CI users in various contexts of speech perception is extremely important to measure the degree of patient satisfaction. The evaluation of CI benefits of the user can be determined by testing speech perception and self-assessment questionnaires that subjectively assess hearing loss associated with communication problems and life style.

Need of the study

Though there are several ways to evaluate the outcomes of a cochlear implant in post-lingual individual, Self-assessment questionnaires for the assessment of CI users are still scarcely developed. Also, there are limited literature report on questionnaires that focuses solely on profiling the Cochlear Implantees development and quality of life. There are three questionnaires in international literature, "The Nijmegen Cochlear Implantation Questionnaire" (NCIQ), "Spatial Hearing Questionnaire" (SHQ) and "Hearing Implant Sound Quality Index" (HISQUI19). In that, HISQUI focuses more on quality of sound based on everyday life situations which is not yet been translated in Tamil context. So, use of such questionnaire in respective regional language can be helpful for the professional to plan therapy intervention and rehabilitation programs and also to refine Mapping. Hence there is requirement to translate and validate it to our population. To profile the quality of sound in post-lingual Cochlear Implantees. To profile the responses of each participants for all 19 items, To establish the relationship between the implantation age and HISQUI19 total score, To find the relationship between the HISQUI19 Total score and age at implantation

Methodology

The purpose of this study was to profile the auditory benefit from Tamil CI users themselves on the functional levels they experience in different everyday life situations for which validated questionnaire "Hearing Implant Sound Quality Index (HISQUI)-2014" a self-assesment questionnaire which is translated into Tamil language and it was validated and checked on 30 post-lingual cochlear Implantees.

Research design

A cross sectional descriptive study was designed to evaluate the sound quality from cochlear implant in individual's personal, everyday listening situation.

Participants

20 random post-lingual Cochlear Implantees who were implanted at MERF-ISH (P) Ltd. were selected and participated in the study. The questionnaire was administered to the 20 participants who were native Tamil speakers and who were able to read Tamil were selected for the study. The overall design of the study was approved by the ethical committee of Madras ENT Research Foundation (P) Ltd., and MERF institute of speech and hearing (P) Ltd. Adult Post-lingual CI users with minimum of 6 month of implant age were selected for the study. Participants were unilateral, bilateral Implantees. In relevance to experience, regular usage (minimum of 8 hours per day) of cochlear implant was considered. Participants of pre-lingual Cochlear Implantees and Implant age less than 6 months were excluded from the study. Irregular usage of implant in their daily life were excluded.

Tools and Test Materials

The translation of this questionnaire was done on the basis of guidelines given by World Health Organization (process of translation and adaptation of instruments, 2008).

1. Forward translation
2. Expert panel back translation
3. Pre testing and cognitive interviewing
4. Final version

Phase 1 - Selection of the Questionnaire

In this phase an extensive review of literature was done to select an appropriate questionnaire to assess the quality of sound in post-lingual CI users. Among all Hearing Implant Sound Quality Index (HISQUI) questionnaire were selected because it is used to measure the subjective outcome of CI user's quality of sound in their personal, everyday listening situations. HISQUI is well structured questionnaire consist of 19 questions with 7 point rating scale; ranging from 7-always (99%)-1(1%)-never

Phase 2 - Forward and Backward Translation

The questionnaire was subjected to translate into Tamil language. In this phase the questionnaire was translated into Tamil language as most of the participants were Tamil speakers. Forward translation (English to Tamil) was done by translator who is proficient in both English and Tamil language with mother tongue of targeted language was chosen. Back translation (Tamil to English) was done by a linguist and professionals in speech and hearing.

Phase 3 -Content Validation

In this phase, the Translated (Tamil) Questionnaire was given to 3 professionals who are native Tamil speakers and they were asked to check the resemblance of each question/statement of the translated one and also the cultural appropriateness. The questions were finalized by the appropriateness of the content relevance with Tamil version of 90% resemblance with the original English version.

Phase 4 -Pilot study

In this phase, Pilot study was done for the participants who were randomly selected to check the appropriateness and structure of the questions and statement for self-administering. After the pilot study final version of

questionnaire was selected for self-administering.

Procedure

Individuals who met the strict inclusion criteria were chosen as the participants of the study. A written consent was obtained from all the participants prior to the administration of the questionnaire for their willingness to participate in the study, where they were informed that it was a survey to know the auditory benefit from Cochlear Implant on the functional levels, they experience in different everyday life situations.

HISQUI19 Tamil version questionnaire was given to participants with Cochlear Implant who met the above inclusion criteria for self- administering. The questionnaire consists of 19 questions, participants were requested to check the answer boxes that best reflect their everyday hearing life. Each item is scored on a 7-point Likert scale: a score of 1 (1%) indicates that the situation is never achievable, score of 2 (12%) is rarely achievable, score 3 (25%) is occasionally achievable, score 4 (50%) is mostly achievable, score 5 (75%) is frequently achievable, score 6 (87%) is almost always achievable and 7 (99%) indicates the situation is always achievable and if a specific situation/ statement was not applicable, participants were asked to check the box N/A (not applicable). Participants were oriented properly to reduce the response bias and answer each question based on his/her own experiences with their CI. Out of 20 participants 12 were interviewed face to face and 8 via E-mail. The total HISQUI score is calculated from the sum of all 19 questions. Missing data and the answer not applicable are treated as missing values. The total score ranges from 19–133. A Total score of <30 indicates a ‘‘very poor’’ level of auditory benefit, 30–59 a ‘‘poor’’ level of benefit, 60–89 a ‘‘moderate’’ level of benefit, 90–109 a ‘‘good’’ level of benefit, and 110–133 a “very good” level of benefit.

Results and Discussion

The aim of the present study is to profile the quality of sound in post-lingual Cochlear Implantees. HISQUI19 Tamil version was administered on 20 adults Cochlear implantees. The data for each objective were tabulated and statistical analysis was done using statistical package for the social sciences (SPSS) software version 16. The internal consistency of the HISQUI19 Tamil version was assessed using Cronbach’s alpha coefficients. The Cronbach’s alpha for total scale was found to be “α=0.94”, indicating a high degree of internal consistency. This nearly corresponds with the “α =0.949” of the original HISQUI19 questionnaire. Out of twenty participants eighteen were males and two were females with mean chronological age of 43.0 (range 23-71 years) and implant age of 2.9 years (range 0.11-11 years). Two participants were bilaterally implanted, Thirteen were implanted only in right ear and Five were implanted in left ear. The below figure 1 shows the mean total score was 81.4 (SD ±18.3), which suggested that subjects had overall of “moderate” sound quality in everyday situation. The distribution of the total HISQUI19 scores. The minimum score achieved was 46, and the maximum was 107.

Quantification of total scores Table 1 shows no participant reported “very poor sound quality” (<30 score), two participants reported “poor sound quality” (31-60 scores), eight participants reported “moderate sound quality” (61-90 scores) and ten participants reported “good sound quality” (91-110 scores). Mertens *et al*., (2015) [11] and Lassaletta *et al*., (2016) [4] study has been supported the current study results that the mean range of adult cochlear implantees was “moderate” auditory benefit for the subjects in their everyday listening situations.

Table 1: Quantification of total scores

Level of sound quality	n	%
Very poor (<30)	0	0%
Poor (30–59)	2	10%
Moderate (60–89)	8	40%
Good (90–109)	10	50%
Very good (110–133)	0	0%

The descriptive analysis that the mean responses ranges from 80% to 47% for 19 items. The response percentage for item 1 was 80% which indicates that the participants were “almost always able to effortlessly distinguish between a male and a female voice” and for item 7 and 12 the response percentage was 47% which indicates most of the participants had difficulty “to understand the movie’s text while watching a movie on TV when music is playing in the background, provided that the volume of the TV is loud enough” and difficulty “to understand the announcement in a bus terminal, a train station or an airport”

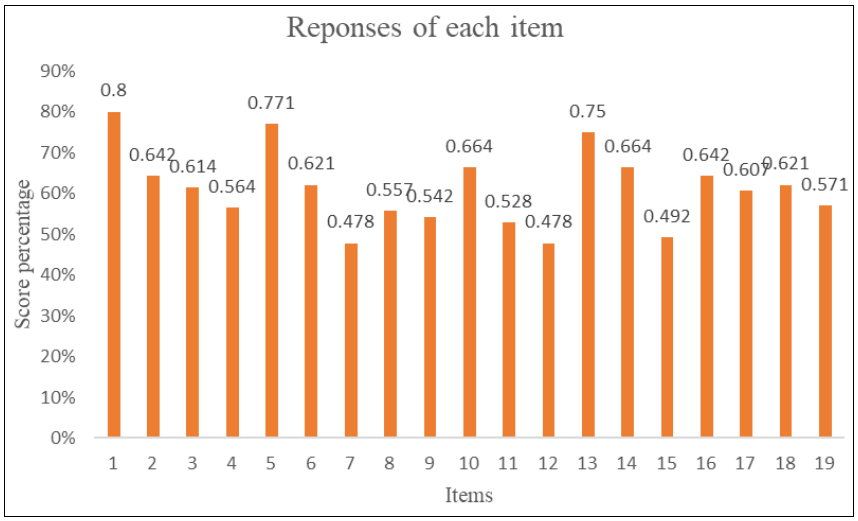

Fig 1: Participant’s responses of each item in percentage

i) Responses based on domains

On descriptive analysis the mean scores (5.05) for the domain "sound localization" was seems to greater than that of other domains. Items on "understanding the news on the radio/ watching TV when others are talking and understanding speech in a public situation" seems to have less benefit when compared to other domains. Similarly Mertens *et al*., found that regardless of the innovations in CI technology, questions regarding listening in background noises and in a hall or station were generally less scored (item 7, 11, 9, 12, 15) and phone-related items (2, 8) were remarkably negatively scored because telephone use in CI users is still seems to be tremendously challenging despite rehabilitation. Additionally, since some test items evaluate music perception, subject's pre-hearing loss musical experience may have predisposed their post-hearing loss music scores. There are various studies which found that CI users' objective speech understanding scores do or do not correlate with level of benefit subjects feel that they have gained from CI use. These discrepancies across studies might be because studies used different questionnaires and tests to evaluate subjects.

Table 2: Participant's Mean scores in each domain

S. No.	Domains	Item No.	Mean
1.	Distinguishing between different voices/speakers	1, 10, 14	4.96
2.	Identifying music sound	3, 6	4.32
3.	Sound localization	5, 3, 16	5.05
4.	Talking on the phone	2, 8	4.17
5.	Watching TV, listening to the radio	7, 11	3.52
6.	Understanding speech in public situations (speech in noise)	9. 12. 15	3.53
7.	Participating in conversations (speech in noise)	4, 18, 19, 17	4.13

ii) The relationship between implantion age and total HISQUI19 scores

Spearman's rho was conducted to find the relationship between implantion age and total HISQUI19 scores which indicates there is no significant relation (p=0.90) was found from all 20 participants.

Comparing the current objective with pervious literatures is difficult because neither study examined the HISQUI19 total score with implanation age. Since Participants did not complete a HISQUI19 prior to implantation pre and post-implant comparisons cannot be made but, since they have severe-to-profound hearing loss, it can probably be safely assumed that their sound quality improved after CI provision and the improvement was due to CI use. However, measuring auditor benefit of day to day life situations is a formidable task because a large number of factors contribute to the final outcome and satisfaction solely depends on the patient's attitude and perception. Similarly, Coelho *et al*. 2009 [6] suggest that participants may unrealistically assess their own functional level. Occasionally CI users have difficulty responding to a particular item because they have never experienced the specific situation described. Thus, duration of implantation use may not influence self-perceived functioning.

iii) Relationship between the HISQUI19 Total score and age at implantation

Results showed that there was no correlation between the total HISQUI scores and age at implantation. Correspondingly in original HISQUI19 German-language validation study they found only a slight and not significant difference between the scores of subjects younger than 60 years at implantation and those older than 60 years, though a stratification was not done in the present study. The possible reason for the lowest score related to self-reported sound quality in 'elderly' subjects could be due to 'a lack of previous exposure to the experiences or situations that some items queried, rather than a worse sound quality' which was hypothesized by Calvino *et al*., (2015) [4].

Coelho *et al*., (2009) [6] stated that older CI users, when they are not at work, they tend to avoid challenging hearing situations and experience more difficulty when communicating with family members. So, this also may contribute for attaining low scores. But Vermeire *et al*., (2005) [18] found similar results of the current study that there were no significant difference in benefit outcomes between the geriatric group (70+ years) and younger age groups for the Hearing Handicap Inventory for Adults and also for the Glasgow Benefit Inventory.

Conclusion

The aim seems to have been realized: the HISQUI19 Tamil version has a good reliability and internal consistency. Notably, the HISQUI19 was convenient for CI users and clinicians because it is easy and quick to complete and easy to interpret. The mean total score was 81.4 (SD ±18.3), which suggested that subjects had overall of "moderate" sound quality in everyday situation. The minimum score achieved was 46, and the maximum was 107. Relationship between implantion age and total HISQUI19 scores indicated there was no significant relation was found from all 20 participants. Thus, duration of implantation use may not influence self-perceived functioning. Cross-sectional evaluation result showed that there was no correlation between the total HISQUI scores and age at implantation. Correspondingly in original HISQUI19 German-language validation study they found only a slight and not significant difference between the scores of subjects younger than 60 years at implantation and those older than 60 years, though a stratification was not done in the present study.Based on the results of this study we may conclude that the HISQUI19 Tamil version is a valid measure of self-perceived sound quality in everyday listening situations in adult CI users with post-lingual hearing loss. It is also a useful instrument for evaluating the subjective outcomes of cochlear implantation and helpful for improving rehabilitation.

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