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Speech , spatial and qualities of hearing in hearing aid users

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I. INTRODUCTION

Hearing is one of the most valuable senses among the five senses, which helps not only to orient us in the environment but also to communicate with others (Carmen, 1977).

The ability of an individual to carry out auditory tasks in the real world is influenced not only By his or her hearing abilities, but also by a multitude of situational factors, such as Background noise, competing signals, room acoustics, and familiarity with the situation. Such Factors are important regardless of whether one has a hearing loss, but the effects are magnified when hearing is impaired.

Hearing impairment can adversely impact the quality of life of a person in terms of functional impact, social impact, emotional impact as well as economic impact (World Health Organization, 2017). Sensori neural hearing loss reduces the ability to hear faint sounds, even when speech is loud enough to hear, they hear as muffled and unclear. Person with sensorineural hearing loss have difficulty in understanding speech, auditory discrimination, listening and understanding in noisy environment, and localizing speech. (American speech and hearing association, 2016). Speech spatial hearing is drastically affected in sensorineural hearing loss.

`Sound occurs around us virtually all time, through multiple sources from multiple locations at different point of time. When a sound is of importance, a listener shifts his/her attention by moving eyes and head towards the source of sound, and listens carefully. Thus comprehends the sound and hence participate in communication, principally in the form of communication. The auditory system deficits are integral to the cascade of the hearing listening, comprehending and communicating. (Tonnesen & Steinmetz, n.d.)

The effect of hearing aid on daily living is not focused in clinical setup only after a person's rehabilitation provided for the same. Various questionnaires have been developed which can be used to assess the effect of hearing ability on daily living and one among them is speech spatial and quality of hearing scale (SSQ). Speech spatial ability is hearing speech in variety of competing context, based on direction, distance and movement, ability to segregate sounds, and also to attend to simultaneous speech streams. The reality of hearing in everyday life is reflected by speech spatial ability. (Gatehouse & Noble, 2003).

Voss (2016) explained auditory spatial perception without vision and the result obtained with late-onset blind individuals suggest that early visual experience plays a key role in the development of both spatial hearing enhancements and deficits.

Noble (1998) found that persons with a high-frequency steeply sloping audiogram configuration could experience relatively more difficulties with spatial hearing and speech understanding in noise than persons with a flat audiogram configuration.

In the present Indian context, after audiological evaluation concentrates on rehabilitation. The Speech Spatial Quality of an individual are often overlooked. The present study will help to analyse the Speech Spatial Quality of a person and how to use it effectively in rehabilitation.

II. REVIEW OF LITERATURE

Hearing is one of the most valuable senses among the five senses, which helps not only to orient us in the environment but also to communicate with others Recently, various questionnaires has been developed which can be used to assess the effect of hearing quality on daily living and one among them is speech, spatial and quality of hearing scale (SSQ). SSQ measures various levels of activity in our daily living like localization, speech in noise, listening effort, quality of life, segregation, multiple speech stream speech understanding. The SSQ has been used in various conditions but hearing aid users has been not focused. There are many versions of SSQ which has been upgraded and in 2003 SSQ of 12 questions have been developed by Gatehouse & Noble, 2003 for easy clinical and research use.

Sensorineural hearing loss reduces the ability to hear faint sounds, even when speech is loud enough to hear, they hear as muffled and unclear. Person with sensorineural hearing loss have difficulty in understanding

speech, auditory discrimination, listening and understanding in noisy environment, and localizing speech. (American speech and hearing association, 2016). Speech spatial hearing is drastically affected in sensorineural hearing loss.

A hearing aid is used by individual with hearing loss and is a small electronic device that is worned in the ear. It amplifies sounds louder so that a person with hearing loss can listen, communicate, and participate more effectively in daily activities. A hearing aid can help people hear better both in quiet and noisy situations.

Speech, spatial and qualities of hearing scale measures various domains of hearing disability. They focused hearing in a variety of competing contexts, distance and movement components of spatial hearing, localization of sound, ability to segregate sounds and to attend to simultaneous speech streams, which reflects the reality of hearing in the everyday world. Quality of hearing experience includes clarity of listening, naturalness and ease of hearing. It takes into consideration the perception of both sounds quality and spatial relationship; hence it is a very comprehensive measure of hearing disability. There are three main sections which have been incorporated in the SSQ questionnaire; they are termed as "speech perception", "spatial understanding" and "identification, separation and identification and clarity".

Sound sources are likely to occur from multiple direction and overlaps which each other, the sounds are also dynamic in nature, where sound sources move around and change rapidly, such environments are often challenging. In such environment, listeners effective functioning is required to focus and identify the sounds (Galvin & Noble, 2013).

Western studies

Mackersie, Pride and Stiles (2001) determined the role of frequency selectivity and sequential stream segregation in perception of simultaneous sentences by listeners with Sensorineural Hearing Loss and result suggested that the ability to perceptually separate pitch pattern and separate sentence spoken simultaneously by different talkers are mediated by underlying perceptual and cognitive factors.

Crandell (1993) assessed speech recognition in noise in children with minimal degrees of Sensorieural hearing loss 8on sentence recognition of and the result reveals that children with minimal degrees of sensorineural hearing loss obtained poorer recognition scores than normal hearing children across most listening conditions. The performance between 2 groups was poorer as the listening environment became more adverse.

Voss (2016) explained auditory spatial perception without vision and the result obtained with late-onset blind individuals suggest that early visual experience plays a key role in the development of both spatial hearing enhancements and deficits.

Liu, Tao, Jiang, Galvin, Fu, Yuan and Chen (2017) analyzed the effect of spatial separation and noise type on sentence recognition by Mandarin-speaking cochlear implant users and the result showed that performance was much poorer in Cochlear implant than in normal hearing listeners for all noise types and spatial separations. Noise type differently affected unilateral cochlear implant users and normal hearing listeners. The limited spectral resolution in cochlear implant users did not appear to affect head shadow.

Litovsky, Parkinson and Arcaroli (2009) measured spatial hearing and speech intelligibility in bilateral cochlear implant users. Result showed that during the early stages of bilateral hearing through cochlear implants in postlingually deafened adults, there is an early emergence of spatial hearing skills. Although nearly all subjects can discriminate source locations to the right versus left, less than half are able to perform the more difficult task of identifying source locations in a multispeaker array. Benefits for speech intelligibility with one versus two implants improve with time, in particular when spatial cues are used to segregate speech and competing noise. Localization and speech-in-noise abilities in this group of patients are somewhat correlated.

Noble (1998) found that persons with a high-frequency steeply sloping audiogram configuration could experience relatively more difficulties with spatial hearing and speech understanding in noise than persons with a flat audiogram configuration.

Gatehouse and Noble (2004) designed the speech, spatial and qualities of hearing scale (SSQ) to measure a range of hearing disabilities across several domains. Attention was given to hearing speech in variety of competing context, and to directional, distance and movement components of spatial hearing. The result implicated aspects of temporal and spatial dynamics of hearing disability in the experience of handicap. The SSQ shows promise as an instrumental for evaluating interventions of various kinds.

Noble and Gatehouse (2004) conducted a study using speech, spatial and qualities of hearing scale (SSQ) on interaural asymmetry of hearing loss. The comparison was focused on self-rated disabilities reflected in responses on the scale. The connections between SSQ ratings and a global self rating of handicap were observed. Result showed that spatial hearing was severely disabled in the group with asymmetry across all SSQ domains. Hence SSQ shows promise in assessment of outcomes in case of bilateral versus unilateral amplification and implantation.

Noble and Gatehouse (2005) found the effects of bilateral versus unilateral hearing aid fitting on abilities measured by the speech, spatial and qualities of hearing scale (SSQ) and the result showed that hearing

speech in demanding context showed benefit with the one aid and further benefit with two in spatial domain, directional hearing showed some benefit with one aid, and particular further benefit in distance and movement discrimination from fitting with two. There was benefit with one aid in quality domain and benefit with respect to listening effort was with bilateral fitting.

Douglas, Yeung, Daudia, Gatehouse, and Gerard (2007) used speech, spatial and qualities of hearing scale (SSQ), to characterize and quantify the auditory disabilities that patients experience with a profound unilateral hearing loss after acoustic neuroma removal. Result showed the greatest difficulty was speech in the presence of noise, situations of multiple speech streams and switching location of unseen objects, and increase listening efforts.

Noble, Jensen, Nayler, Buller, and Akeroyd (2013) developed and evaluate 12 item versions of speech, spatial and qualities of hearing scale for use in clinical a rehabilitation setting and result revealed similar results to SSQ of 49 question version.

Banh, Singh and Pichora-Fuller (2012) analyzed affects responses on the Speech, Spatial, and Qualities of Hearing Scale (SSQ) by adults with minimal audiometric loss and the result showed the best scores from younger and older adults with "normal" hearing thresholds, these results provide clinicians with information that should assist them in setting realistic targets for interventions for adults of different ages.

Dwyer, Firszt, and ruder (2014) evaluated effects of hearing mode on everyday communication among adult unilateral listeners using the speech, spatial and qualities of hearing scale (SSQ) and the result showed that adults irrespective of better ear hearing mode, including those with the normal hearing ear, are at a disadvantage in all aspects of everyday listening and communication.

Andrade, Lorio, and Gil (2016) measured Speech recognition in individuals with sensorineural hearing loss in presence and absence of noise and the result revealed there was no significant difference between right and left ears in any of the tests. The mean number of correct responses in the speech recognition test with pictures, live voice, and recorded monosyllables was 97.1%, 85.9%, and 76.1%, respectively, whereas after the introduction of noise, the performance decreased to 72.6% accuracy. Hence the conclusion, performance was poorer when the noise was introduced.

Moulin and Richard (2016) explained sources of variability of speech, spatial, and qualities of hearing scale (SSQ) scores in normal-hearing and hearing-impaired populations and the result revealed that strong similarities between SSQ scores obtained across different populations and languages, and between SSQ and short forms, underline their potential international use.

Mishra, Sinha, Kumar, Hota, and Das (2016) compared functional benefit of unilateral versus bilateral hearing aid fitting in elderly population using Hindi transadaptation of speech, spatial, and qualities of hearing scale (SSQ) and the result revealed that two hearing aids work more effectively at the basic level of function (direction, distance, movement), removes the need for strategic positioning and re-positioning and enhances binaural processing.

Lotfi, Nazeri1, Asgari, Moosavi, and Bakhshi (2016) conducted a psychometric study Iranian Version of Speech, Spatial, and Qualities of Hearing Scale and the result showed exploratory factor analysis (EFA) indicated a four-factor solution for P-SSQ that jointly accounted for 52.40% of the variance observed. Confirmatory factor analysis approved the three factor solution but proposed a possible fourth factor. The Iranian version of the SSQ has acceptable psychometric properties and it will be helpful for assessing different kinds of communication abilities in the Iranian elderly population.

Bamiou, Iliadou, Zanchetta and Spyridakou (2015) assessed the validity of the Speech, Spatial, and Qualities of Hearing Scale (SSQ), the (Modified) Amsterdam Inventory for Auditory Disability (mAIAD), and the Hyperacusis Questionnaire (HYP) in adult patients experiencing listening difficulties in the presence of a normal audiogram and the result revealed that the SSQ correlated strongly with the mAIAD and the HYP, and correlation was similar within the clinical group and the normal controls.

Moulin and Richard (2016) Validated French-Language Version of the Spatial Hearing Questionnaire, Cluster Analysis and Comparison with the Speech, Spatial, and Qualities of Hearing Scale and the result reveals a comparison of factor analysis outcomes among the English, Dutch, and French versions of the SHQ confirmed good conceptual equivalence across languages and robustness of the SHQ for use in international settings. In addition, SHQ and SSQ scores showed remarkable similarities, suggesting the possibility of extrapolating the results from one questionnaire to the other. Although the SHQ was originally designed in a population of cochlear implant patients, the present results showed that its usefulness could easily be extended to non-cochlear-implanted, HI subjects.

Indian studies

Arun and Shany (2017) according to the unpublished research study on speech, spatial and qualities of hearing in tea factory workers reveal that there is a significant difference between the subjects with normal hearing sensitivity, unilateral hearing loss and bilateral hearing loss which also indicate major effect of subjects working in the presence of noise.

Safa and Shany (2017) the unpublished study demonstrates that speech, spatial and qualities of hearing scale in sensorineural hearing loss that indicates persons with moderate to severe sensorineural hearing loss have persistent issues with speech spatial and qualities of hearing .

III. METHODOLOGY

The aim of the study was to assess the speech spatial qualities of hearing in individuals with hearing loss using hearing aids.

Subjects

10 individuals in the age range of 20-50 years were diagnosed having moderate to severe sensori neural hearing loss and wear hearing aid in both ears since 2 years participated in the present study.

Individual who were having congenital hearing loss, conductive and mixed hearing loss were excluded from the present study.

Materials:

The speech spatial and quality questionnaire (SSQ12) given by Noble & Gathouse, 2003 was translated to Malayalam by a professor and was validated by 5 speech language pathologist and audiologist whose native language was Malayalam. 12 questions based on speech in noise (3), hearing in multiple speech streams, localization, distance and movement (2), segregation, identification of sound, quality and naturalness, and listening effort were used for the present study.

Procedure

All the individuals were counselled regarding aim and procedure of the study was informed and prior consent was obtained. They were also given a short introduction on SSQ-12 questionnaire and ask to complete the questionnaire.

Scoring

The participant were asked to rate on the basis of 0-10 were 0 was difficulty and 10 was no difficulty.

Analysis

Self rating score obtained from the individuals were analysed and the results were discussed in the next chapter.

IV. RESULT AND DISCUSSION

The aim of the present study was to assess the speech spatial and quality of hearing in bilateral using hearing aid users.

The obtained data was analysed and results are discussed below.

Figure 4.1: showing the mean scores of speech, spatial and quality of hearing in individual with hearing aid subjects for each questions in the questionnaire.

Figure 4.1, showing the mean score for questions 1 to 12 of SSQ 12. From the above graph clearly seen that there is variation in the mean scores ranging from 0.25 to 0.43 for the questions. The highest mean score was

seen for Q2 (0.43) followed by Q7 (0.4), Q3 (0.37), Q4 (0.36), Q8 (0.35), Q1&Q11C (0.34), Q2 (0.32), Q10 &Q12 (0.31) and Q5 (0.3).

	mean
LOCALIZATION	0.25
DISTANCE AND MOVEMENT	0.25
MULTIPLE SPEECH STREAMS	0.31
IDENTIFICATION OF SOUND	0.31
LISTENING EFFORT	0.31
QUALITY AND NATURALNESS	0.34
SPEECH IN NOISE	0.35
SEGREGATION	0.43

Table 4.1: showing the mean scores of different areas of speech spatial and quality in subjects with hearing aid in both ears.

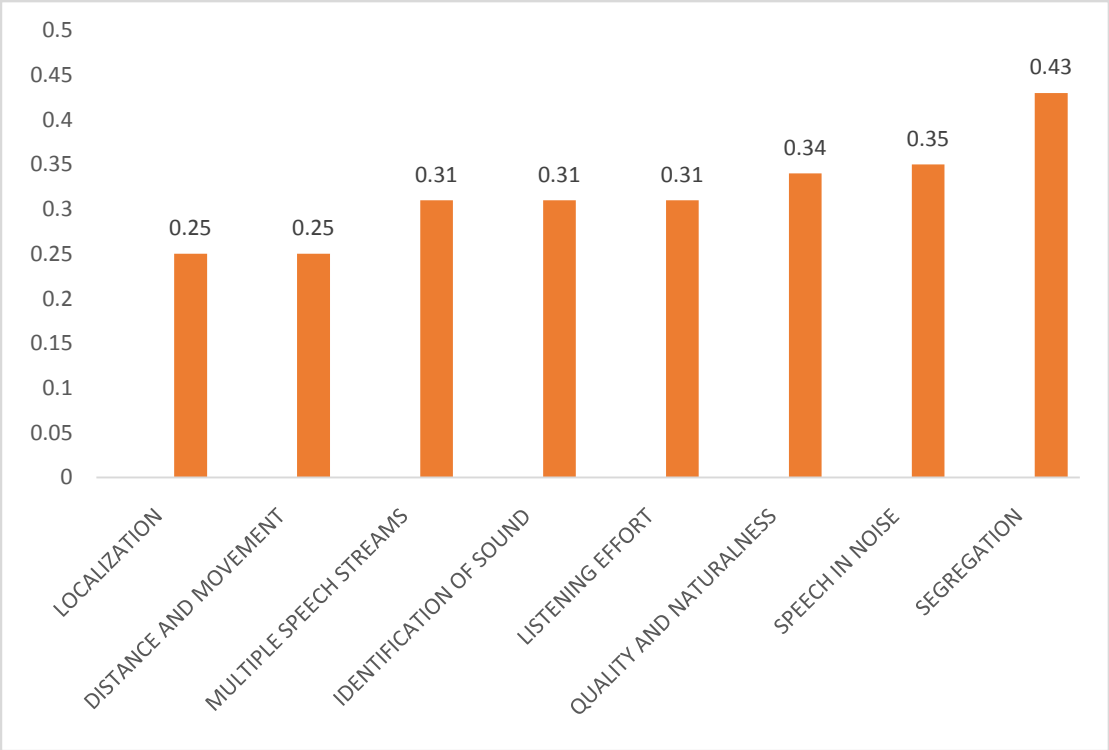

Figure 4.2: showing mean scores of areas of speech, spatial and quality in subject with hearing aid in both ears.

From above figure and table it is very evident that highest mean scores was seen for segregation (0.43), followed by speech in noise, quality and naturalness, listening effort, identification of sound, multiple speech streams, distance and movement and localization.

V. DISCUSSION

The above results reveals that speech, spatial and quality for hearing are mildly affected in subjects using hearing aid in both ears. The present study is in accordance with done by Gatehouse and Noble (2004) who found lower SSQ ratings of hearing impaired persons.

The results suggests that disability measures provides additional information about the hearing status compared with the behavioural impairment measures. The management should be focused on the disability of

the patient which can help in coping up with issues faced by people due to the effect of hearing impairment. The quality of hearing also can be improved.

VI. SUMMARY AND CONCLUSION

The auditory system serves other issues besides speech hearing, such as localization, identification, and so on. Hearing loss not only affects the hearing status for an individual it also has an adverse effect on the daily activities. They have difficulty to follow speech in various competing situation which affects the overall performance of the individual in turn affecting the quality of life.

10 individuals in the age range of 20-50 years were diagnosed having moderate to severe sensori neural hearing loss and wear hearing aid in both ears since 2 years. All the individuals were counselled regarding aim and procedure of the study was informed and prior consent was obtained. Were asked to complete SSQ-12 questionnaire given by Noble & Gathouse, 2003 was translated in to Malayalam in 0-10 scaling where 10 was no difficulty and 0 was difficulty.

The overall results reveals that speech spatial and quality for hearing are mildly affected in the subjects using hearing aid in both ears.

The results suggests that disability measures provides additional information about the hearing status compared with the behavioural impairment measures. The management should be focused on the disability of the patient which can help in coping up with issues faced by people due to the effect of hearing impairment. The quality of hearing also can be improved.

In summary, we conclude that in clinical setting it is important to measure speech spatial quality. It can be used in the rehabilitation of the hearing impaired.

Limitation of the study

- Subjects size is very small

Future implications

- More number of subjects can be included for the study.
- The study can be conducted on children using hearing aid.
- Study can be carried different degrees of hearing loss.

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