

Using Music Therapy in (Re) Habilitation of Prelingual Deaf Cochlear Implant Children

*Samia E Bassiouny, Marwa M Saleh, Dina AE Elrefaie and Mary S Girgis

ENT Department, Phoniatic Unit, Faculty of Medicine, Ain Shams University, Cairo, Egypt

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*Corresponding author: Samia E Bassiouny, ENT Department, Phoniatic Unit, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Abstract

The efficacy of music therapy in management of various communicative disorders, (including hearing impairment) is well established, still there is no available and documented schedule for rehabilitation of hearing impaired children with the help of music intonation therapy in Arabic language. The exact role of music therapy is not yet validated on Arabic speaking children having hearing impairment.

Objective: To test the efficacy of a specially designed music program to be used in (re) Habilitation of cochlear implant children during their first years of auditory habilitation in order to improve their communicative abilities.

Materials and methods: The study was carried out on 20 Arabic-speaking pre-lingual deaf children with cochlear implants (for not less than a year), aged between 3 and 6 years. They were subjected to our innovated music therapy program for 3 month (2 sessions/ week) and were assessed at the end using auditory closure test for each song.

Results: The results revealed a highly significant relationship between the introduced songs and the auditory closure test results, which reveals the acquisition of new active vocabularies.

Conclusion: Music therapy is a fruitful way of learning and transforming information. In cochlear implanted children, it was found that music therapy is beneficial in increasing their size of active vocabulary, thus enriching their expressive language.

Keywords: Music Therapy; Cochlear Implant

Introduction

Music therapy was defined by Myra [1] as a special way of music introduction to the patient in order to improve his/ her way of living by changing one's behavior in a positive way. It is a way that's been used to encourage development in all one's abilities including psychological, motor, and learning abilities. It is a very effective method using music as a route of learning, as everyone has a special response to at least one style of music. Also, as stated by Benezon [2] music therapy is the field of medicine which studies the man-sound- man complex in order to use movement, sound and music to open communication channels to produce therapeutic, psycho-prophylactic and rehabilitating effects in man society.

Boxill [3] stated that music therapy offers a non-verbal means of making contact. This, in turn makes music a very beneficial media through which cochlear implanted children could easily go through the transition developmental zone between nonverbal and verbal stage. Following the implantation, children are usually put under stress by the parents to communicate verbally as early as possible, which is still hard to the children until they reach the proper verbal communicating stage. Music, if used, in this period can lessen the stress [4].

Problems Facing Cochlear Implanted Children

The major problem in pre-lingual deaf children in general, particularly in cochlear implanted children, is the lack of normal neurological development. For the normal neurological development of auditory cortex to happen requires early exposure to hearing stimuli (even during intrauterine life). Those children lack being stimulated with hearing stimuli, thus there is a delay in their neurological development as well as delayed language development, cognitive abilities and perceptual abilities. In other words, the overall development of children neurologically is negatively proportionate to the sensory experience [5,6].

Objective

To test the efficacy of a specially designed music program to be used in (re) habilitation of cochlear implanted children during their first years of auditory habilitation in order to improve their communicative abilities.

Materials and Methods

This study included 20 patients with delayed language development due to hearing impairment with cochlear implants.

They were attending the unit of Phoniatics, Ain –Shams University and Nidaa Association for cochlear implanted children.

Inclusion criteria:

1. Age range: 3-6 years.
2. Sex: no preference.
3. Cochlear implant timing: not less than one year ago.

Exclusion criteria:

1. Children with hearing impairment as a part of another syndrome.
2. Children with mental retardation.
3. Children with history of cochlear implant insertion for less than a year.

I. Elementary diagnostic procedures:

- 1) Patient interview and history taking.
- 2) General examination.
- 3) Vocal tract examination.
- 4) Ear and nose examination.

II. Clinical diagnostic aids: Evaluation of the various aptitudes by formal testing: Mental age using nonverbal intelligence test of Snijders-Oomen (1979). Language evaluation: to assess and group children according to their language receptive and expressive level. It was done through various methods subjectively.

III. Additional instrumental measurements: Audiological evaluation by audiogram and tympanometry.

Method – Therapy Program The program consisted of newly improvised 6 songs, which are built according to criteria that are suitable for cochlear implanted children. Each song is composed as a short story with simple easy words and melodic characters that suit the bionics ears. Songs were auditioned by the last author as the singer with a soft piano playing as an accompanying musical instrument played by a professional pianist. This was meant to avoid the over stimulation of their bionic ears. Each session was divided in time as follows:

- a. 10 minutes: telling the song’s story and stressing on the auditory closure words which were intently chosen in order to increase the size of vocabulary of each child receptively and expressively. This was done through the use of flash cards and sometimes with the cartoon video done for each song.
- b. 25 minutes practicing the song with live singing and trying to encourage children to sing along. Also, modeling the auditory closure game was done with the help of the
 - c. Class teacher, especially in young children.
 - d. **10 minutes:** playing games around the lyrics of the song to make sure that they understand the whole meaning of the song. This was done through : asking “WH” question about the song (for older children), asking to bring the intended card (for non-verbal and young children), playing with rhythmic instruments, playing the video of the song and giving the chance for kids to sing along if they desire to.
 - e. Each song contains five intently chosen words that each
 - f. Child was supposed to complete it as a part of the auditory closure test.
 - g. At the last session of each song, each child was tested 3
 - h. Times separately in order to know the average range of words that are told by each child to accomplish the auditory closure test.
 - i. The child gets one mark for each uttered word as long
 - j. As it is meant by the child to be in its certain position and with its correct rhythm and melody, even if it is said with phonological errors.
 - k. This average number of words is then calculated and
 - l. Compared to the pre- therapy auditory closure test.
 - m. Additional observations about any special response, reactions, or even odd words produced by any child were written down during the session {which will be discussed later in the discussion chapter}. The results of each song’s auditory closure test were statistically analyzed and tabulated separately.

Results

Table 1: Description of pre and post songs auditory closure.

	Mean	±SD	Minimum	Maximum	Median	IQR*		P	Sig
Pre. Test	.00	.00	.00	.00	.00	.00	.00	0.001**	HS
Posttest song I	2.17	1.60	.00	4.00	2.45	.35	3.80	0.001**	HS
Posttest song II	2.54	1.97	.00	5.00	3.00	.52	4.30	0.001**	HS
Posttest song III	2.32	1.60	.00	5.00	2.15	1.15	4.00	0.001**	HS
Posttest song IV	2.43	1.86	.00	5.00	3.00	.00	3.85	0.001**	HS
Posttest song V	2.07	1.80	.00	4.70	2.50	.00	4.00	0.001**	HS
Posttest song VI	1.97	1.66	.00	4.00	2.00	.15	4.00	0.001**	HS
Posttest all songs	13.49	10.13	.00	25.90	14.60	3.67	23.80		

Table 1 Shows that the mean pretest auditory closure was 0±0 words, the mean Posttest auditory closure for song I, II, III, IV, V, and V was 2.1 ±1.6, 2.5 ±1.9, 2.3 ±1.6, 2.43 ±1.86, 2.07 ±1.8, and 1.9 ±1.6 respectively. The mean total posttest auditory closure

after all songs was 13.4 ±10.1. (Table 2) Shows a highly significant difference between the six songs as regard posts auditory closures. Post hoc test showed that song II had the highest mean (Best Result) compared to song IV (2.54±1.97 Vs 1.97±1.6, respectively).

Table 2: Comparison between the six songs as regard post auditory closures.

	Mean	±SD	Median	P	Sig
Posttest Song I	2.17	1.60	2.5(0.4-3.8)	0.001‡	HS
Posttest Song II*	2.54	1.97	3(0.5-4.3)		
Posttest Song III	2.32	1.60	2.2(1.2-4)		
Posttest Song IV	2.43	1.86	3.0(0-3.9)		
Posttest Song V	2.07	1.80	2.5(0-4)		
Posttest Song VI*	1.97	1.66	2.0(02-4)		

‡Friedman test; * Posttest Song II vs. Posttest Song VI (S) by post hoc test.

Discussion

Music has been a very joyful medium to ease the exchanging process of information. It alleviates the stress, brings enjoyment to children, and it gets them out of the stressing mood of the learning process, as it introduces the learnt material, in a hidden funny way. As told by Wigram et al. [7], that music facilitates turn taking, vocal and verbal actions. Holck [8] also, proved that music has a positive effect on children' social and preverbal skills.

On the other hand, using music facilitates the process of learning through providing a fun media through which information is passed easily, smoothly, and clearly to the child. The child, then, is not under the pressure of "you ought to learn something from this session" concept. Instead, he is learning new concepts, new vocabulary, and new movements through a hidden pathway of music and its effect on his neurological and psychological systems. This actually contributes with what Kirschner [9] introduced in their study, where they discovered the ability of music to enhance child's rhythmic movements and social abilities which are very important parameters in the learning process. Thus, music is a fruitful, easy, cheap and effortless method to be used as a conventional language therapy, as summarized by Fukui, Toyoshima [10]. As they found that music helps in the process of resolution of memory, cognitive, and learning problems. In this study, some facts and results were clearly revealed through the practice of music therapy with cochlear implanted children.

These results are categorized into the following: Song criteria for cochlear implanted children.

- Environmental criteria for music therapy to fulfill its goals.
- The outcome of therapy according to the cochlear implant age and duration, language development, chronological age, and special criteria for each song.

Song criteria for cochlear implanted children

Songs made for cochlear implanted children should have certain criteria

Rhythm: Although rhythm was not considered a problem to be perceived by cochlear implanted Children as stated by Stordahl

[11]. It was shown that it should be a moderate tempo in order to enable the child to understand the lyrics as advised by Darrow [12]. As what was observed in song I, when the children couldn't catch up easily with the lyrics, meaning, and goal because of the fast rate of the song (although, it was intended to be as slow as possible, but it was still fast for those kids). So, it had to be introduced with the last author's voice at a slower rate until they became capable of getting the meaning of the lyrics. Later on, it was introduced with the rate that it was previously composed at. This is done with keeping in mind to avoid monotonous non-rhythmic slowing down of the whole rhythm until the song losses its character which sways us from the goal of teaching those children the supra-segmental part of rhythmic speech.

Tones and pitch: As this element appeared to be the most difficult one to be perceived by cochlear implanted children due to different problems and programming techniques as told by Gfeller et al. [13]. so, in order to encourage those children to sing along and easily acquire those tones, those songs were composed with less musical tricks (as difficult scale, higher register, or fast and unexpected movement from one note to the other). Almost, all of the songs were composed with the familiar lovely umbrella shape scale (with lower tones at the end and the beginning), or falling scales. They also contained lots of repetitions of the same words with different tonality, which helped to lengthen the song and giving it a proper shape without increasing difficulty in adding many lyrics within the phrase, as advised by Pai [14] and Gfeller et al. [13] These criteria made it easier for the children to sing along, however not exactly on tone (may be higher or lower). This is exactly what was expected from children (even normal hearing ones) during singing, as they are not supposed to have an accurate singing cue till later on during their childhood development which exactly was told by Gfeller et al. [13].

However, in this study, it was noticed with an interesting child (who actually could differentiate between higher and lower notes (in song I and II) and sang them pretty much correctly, with pointing up (in the rising pitch) and down (in the falling pitch). This actually meets up with the discovery made by Gfeller et al. [15], and Rocca, Tucker [16] who stated that there could be a small number of cochlear implanted children that could sing accurately on note especially in higher pitch range depending on the capability of the

child and accuracy of music training. This boosted up the idea of: “although children aren’t supposed to be accurately on note during singing, training with some naturally skilled children can improve this ability (even in hearing impaired children)”. That leads us to the fact “It is never impossible for the young hearing impaired children with a cochlear implant to sing accurately.”

As a result of training on singing accurately, these children will be brought up acquiring easily the accurate supra- segmental level abilities later on in their lives. This is in fact what forms a great obstacle in the fully developed language adults who will still have a stigma of hearing impaired language development that could be detected in their supra-segmental aspect of their speech.

Accompaniment: During this study, authors have been introduced to different expectations that are made by people about music therapy. One of those unusual expectations is that music therapy should include instrumental playing (even more than one instruments at a time) in order to attract the child to the content of therapy. However, in our program, it was clear that the less the accompaniment is, the more the focus of child’s attention is. This is done purposely in order to avoid overstimulation of their premature and delicate auditory system. We used the piano as the accompaniment for its nearly calm and comforting sound. Also, the recordings of the songs were made with a higher intensity of the vocal track than the musical one in a trial to clarify the lyrics and phonology of the uttered words. That was done according to the notification made by Looi et al. [17], who advised that musical instrument should be chosen according to the child’s own preference and criteria of perceiving its timbre through cochlear implant device. Results about different instrumental playing (e.g. shakers, bells, and triangles) were revealed during our course through making children themselves play the rhythmic instrument as an accompaniment. This was done as a trial for them to sense the tonicity of the words in song I (zæ.r.ʔæ, hɑm.rɑ, ʔes.wed, safra). Also, this was intended to encourage the nonverbal children to express themselves, as they were demanded to play two notes while making the auditory closure for those words, as stated by Gfeller et al. [13].

This helped to observe the following:

1. It worked better for older age groups (5-6 years) as they were mature enough not to be distracted with the instrument itself (which was very obvious in the little ones).
2. The song rhythm should be clearly represented in the Song itself in order to facilitate children’s Participation (as in song I (ta... tti...)).
3. Children of all ages were annoyed with the sound of triangle and bells (for their higher frequency and intensity sounds).
4. They preferred shakers for their lower frequency and Intensity sounds, attractive colors, and their easier handling.

Lyrics: It is always thought that lyrics should be familiar and coincides with the child’s own developmental stage as proposed by Gfeller et al. [18]. This is exactly what was discovered in this study as familiar lyrics tend to be caught much easier and quicker than non-familiar ones. As what happened in (Song III), where children

who were able to sing along from the first introduction of the song; they were found struggling during the introduction of this song as for the unfamiliarity of the words used in it (saj.aad, sen.nar.toh).

However, it is still believed that the music therapist should get benefit of music by enhancing new and unfamiliar vocabulary growth as told by Olszewski et al. [19]. That actually was proved through their auditory closure scores later on in this song which was nearly the same for each child compared to previous songs. This is also what happened in (song4), where an unfamiliar not used vocabulary was used as (gor.naal) meaning “news paper”, “this is a difficult vocabulary that is rarely used in our society, because of the appearance of other media and cellphones news”. In this song children were able to acquire and utter this new semantic object. Thus, however it is advised to compose songs using familiar words and lyrics, one shouldn’t ignore the role of music therapy in such learning new necessary semantic groups which should be with their gradually and slowly introduction with the use of visual aids and explanation (which is easier with the music therapy usage).

Story element: Although it was not discussed before, that music activity should have a meaningful criteria in itself, in order to get children properly involved in the musical activity, it was clear through this study that adding meaning to the activity helped more in building and exploring their language abilities, and expression. This meaning could be a story or sequential movement activities. This study was more dependent on the story elements in order to avoid movement activity for the fear of external part of cochlear implant to move or fall down as advised by Gfeller et al. [13]. Having a sequence of events in the musical activity helped in the easier inclusion of the new learnt vocabulary in the everyday life and made it easier for the child, later on, to expect and learn longer sentences.

Environmental criteria for music therapy to fulfill its goals

Besides the fact that the music therapist should be in collaboration with the speech therapist, audiologist; he/ she should be in direct contact with the teacher or the therapist of the class (as attending the sessions together) which was advised by Gfeller et al. [13]. This enables the music therapist to easily establish a closer relationship with the children (especially during the first sessions). It also helps the music therapist in building up expectations about the children: (which children are shy, nonverbal, and in need of motivation) which consequently facilitates the process of designing a proper individualized plan for each child. In fact, it was so struggling through the first sessions when the teachers of the class had to come late, and dealing with the children was only by the music therapist (the last author in this study). Feeling lost in the maze of figuring out these children abilities, controlling the class, and explaining the idea of the sessions. The second important issue is the type of therapy: individual vs. group therapy. Group therapy is found to be more beneficial in music therapy sessions. As in group therapy children are more prone for each other’s motivation and getting jealous of each other to give a better response to music therapy.

Besides that, the environmental atmosphere itself should be a funny motivating one. Motivation is reached through accomplishing each child his/ her specifically planned goal; as reaching the goal itself is considered to be as a motivation, accordingly that will be rewarded. Rewarding could be as simple as an applause, stickers, and candies; as children are easy satisfied clients. In fact, even music itself has this motivational support; as sometimes children responded better when they knew that they will watch the music video at the end of the session. Lastly, the most important criteria that the environment should have are the suitable calmness and being quiet. This could be accomplished through training while using sound proof areas, proper isolation, and wide surface area in order to give a proper space for each child to sit or move freely.

The outcome of therapy according to the cochlear implant age and duration, language development, chronological age, and special criteria for each song

Effect of cochlear implant age and duration, and expressive language development: In spite of the well-known fact that age and duration of cochlear implant insertion plays a significant role of the language development of those children, in this study it was revealed that those factors didn't play a major role of acquiring new vocabularies through songs, which was tested by the auditory closure test. This may clear up the fact of the importance of music therapy in enhancing language development in children with late cochlear implant insertion and shorter duration of usage.

In fact, those children are thought to be struggling through the traditional therapy programs which were not revealed in our study. Although, in this study, it was revealed that there is a positive significant correlation between the development of the active vocabulary of the child and the results of the auditory closure test, however, this shouldn't discourage us from introducing such program to the nonverbal children as they gain development in other domains of communication as revealed by Holck [8]. Language isn't only expressive. This is observed during this study during the training of a "5year old female, non-verbal" and her group which were 6 years and beyond. It was noticed that those kids responded positively with gestures and uttering few words during the sessions. Although, they didn't accomplish the meant goal of auditory closure testing or expressing words, their response revealed that music paved the way to the development of their language abilities.

Effect of the chronological age on the efficacy of the program and the way of introduction: Although, it was advised by Gfeller et al. [13], that songs should be introduced first with live singing, and then accompaniment is introduced later on. It was discovered that for the younger or the non-verbal children, using music tracks; video and singing along made a better response compared to the use of cards or live singing alone. Although, in older, verbal children, the use of cards and singing along was more beneficial as they were distracted more with video and hindered to sing along. This was observed in this study while training a (3year and 6months male, non-verbal) and a (2year 8months, non-verbal and non-social).

The first one only swayed with rhythm, clapped along and sometimes uttered (?æ.?æ) instead of zæ:zæ. While the other child

who was so shy, not uttering any word or responding positively with his teacher, which made her suspect cochlear implant problems, responded positively after 1 month of therapy with gesture" swaying his hand" and saying "kæ.mæ.kæ" instead of "sæ.mæ.kæ" at home and during sessions. In fact, it wasn't expected to get any utterance or response from these children, but both responses boosted up our energy and made it clear that there is nothing called impossible. So, one should put a goal that suits every child condition, but never ignore the unexpected results, neither to generalize it. Also, this could be proved with the revealed results, as age was considered as a significant factor for the better results in all the songs except for songs III and IV. These songs contained more familiar vocabularies, that even younger children could recognize them easily.

The effect of the special building criteria for each song on the results: It was intended through our study to build up each song with special criteria of the sounds it contains. As for songs II and VI, they were loaded with the /g/ sound (1.5 KHz). While songs I and III were loaded with sound /s/ (4 KHz). Lastly for songs IV and V, they were loaded with sound /h/ (1.5 KHz). According to the results, there was certain variation in the result of each song's auditory closure test as following: Although songs II and VI were loaded with the same sound /g/, song II had higher scores than song VI. This could be explained by the harder melodic construction of song VI and the more complex vocabulary content. The same was also observed in song IV and V, where they were loaded with the sound /h/; as song IV had higher scores than song V, which is also explained by the lyrics' familiarity.

In song I and III, it was observed that they had a Considerable average scores as they lie in the middle of the songs' order (according to the results of auditory closure test), in spite of being loaded with the highest frequency sound /s/. This could be explained by the fact that their rhythmic quality, familiar lyrics, and interesting visual aids helped in the alleviation of the difficulty of the content of the high frequency sounds. To conclude, the outcome of therapy according to language development, and special criteria for each song 5 are affecting clearly the nature of the child's response to music therapy. One should accept variable results of each child according to these factors, and should put individualized acceptable goals for each child according to this status. However, one should be malleable enough to accept either higher or lower responses than the one expected and to search for causes and the way of gaining maximum responses. Also, other factors such as chronological age should affect the way of the introduced materials, either with singing along, cards, and or video, as mentioned before.

Conclusion

Music therapy is a fruitful way of learning and transforming information. In cochlear hearing implanted children, it was found that music therapy is beneficial in different ways.

- i. Being an attractive method through which children's attention is enhanced and focused on the given learning materials.
- ii. A way to abolish the shyness and social withdrawal of children. It helps them to socialize better and get out of their egocentricity.

iii. It enhances the children's expressive abilities towards the uncommon vocabularies.

iv. It creates a motivational atmosphere through which the child is encouraged to express freely.

v. It forms an easy medium through which phonological errors could be corrected without additional stressful situation for the child.

vi. It formulates a very useful method to actively teach any difficult, new and unfamiliar vocabularies.

vii. It doesn't only enhance the segmental aspect of phonological development, but also the supra- segmental level development; as it helps in recognition and discrimination of different pitch direction, proper timing of utterance and tonicity.

viii. It helps in the development of nonverbal communication ways of the child

Recommendations

It is recommended to conduct this study as a case- control study with larger sample size. It is recommended to standardize a test for detection of the improvement of sound utterance and sound detection in cochlear implant children. Music therapy should be a part of the language intervention program of children with delayed language development due to Hearing Impairment with cochlear implant device. It is recommended to improvise more songs to involve more semantic categories and more.

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