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The role of oral- motor training in Sound discrimination in the Hearing impaired with assistive equipment

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ABSTRACT

The study aims to determine the role of oral-motor training in the discrimination of sounds regarding the equipped hearing-impaired category, which is based on the approach of studying a sample consisting of two cases carrying cochlear implants and a hearing aids. In addition, we relied on “Teep” test specialized in the evaluation of auditory and speech abilities in the hearing impaired. And through the results after the initial and afterwards measurement we find that oral-motor training did not reflect positive results on the side of auditory discrimination but had a role in the improvement of the pronunciation aspect (lips reading).

Keywords: The Hearing impaired; Cochlear implants; Hearing aids; Oral-motor training; Sound discrimination; Disorders articulation.

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INTRODUCTION

The hearing sense is considered an important one due to many capabilities being depending and based on it in order to evolve, like language, especially since the relationship between hearing and articulation is regarded as a correlated one. Therefore, there is no existence of speech without hearing, and thanks to the technological advancement, the hearing-impaired category is capable of benefiting of high-tech to compensate the hearing deficiency and getting advantage of the auditory functioning remains.

The first technique was a hearing aid that works to amplify sounds in which a great number of hearing impaired people used. The second was known as the cochlear implant that captures auditory signals that stimulates directly the auditory nerve. The first cochlear implant in Algeria occurred in 2003 to two cases in **Mustapha Bacha Hospital**. Therefore, we conclude that hearing aids became an effective and available mean, except that it alone isn't sufficient and there must be an exposure of training sessions for the hearing impaired for the sake of fostering auditory development as well as improving their linguistic abilities. Even more, these training sessions are dependant to strengthen the patients according to their degree of hearing impairment.

In addition, these training sessions base a lot on many qualified techniques:

- Manual Communication: Used by deaf people as a replacement for talking.
- Lip-reading: A method of reading by visually interpreting the movement of lips.
- Auditory training: It uses and works on stimulating the remaining auditory functions.
- Oral Communication.

These methods differ in the technical aspect and their therapeutic foundation, except that they are common and share the same general goal: The improvement of the base for communication in a child with hearing disability.

In our study case, we attempt to depend on new methods that are unusual and focus on the motor training, and encourages us to motivate and promote field researches, especially to ensure the fostering of the hearing impaired category, particularly in the reality on the Algerian ground that extremely lacks modern curative techniques, making it difficult in that domain, especially for the specialists in their entry level in the field.

1.2. The problem:

Linguistic growth requires the existence of functional coordination between sensory receptors and the exits of vocal production, and since language is an acquired function dependant on the sensory and motor aspects, the compatibility between them is necessary for language development and proper pronunciation, and any defect on their functional level could effect on the progress of language development as well as reflects badly on the process of communication.

Hearing impairment is considered one of the disabilities that represent an obstacle in the face of language development, given that hearing is one of the most important senses on the perception and production of speech, in which the linguistic system requires healthy auditory and sensitive system to frequency ranges of sound-waves (400-500 Hz), and that is why the hearing impaired face a major difficulty in perceiving auditory signals processed in the auditory system, considering they perceive speech in a different way than those with normal hearing and face big challenges in learning the right method for articulation, so the effect of it differs than normal speech sounds according to the severity and degrees of hearing loss (shoual, 2018, p. 327).

And through the latter, it is possible to say that the relationship between hearing and speech changes has an interlinked correlation, in which speech cannot be uttered if hearing is uninvolved. Furthermore, scientists went beyond that, stating that the ear is what conditions the sounds and not the opposite (Mazel, 1980, p. 33)

Where also studies have specially concluded the patterns of common disorders in the hearing disabled category with the existence of four types: **Distortion**, it occurs when the pronounced phoneme carries the main elements of the intended voice. **Omission**, it happens when the child deletes a sound or more from a word, which will consequently change its meaning. **Substitution**, is the replacement of a sound/phoneme with another one that isn't identical and it usually happens in the beginning or the end of the word. **Addition**, inserting one or extra sounds that could alert the meaning of the word. (Al-Ruseen, 2016, p. 434)

With technological advancement, hearing disorders became a topic not as challengingly difficult as it used to be in the past, especially due to the prominence of means that assist the hearing-impaired individual to exploit and activate the remaining functional auditory pathways, like hearing aids (which causes sound amplification) or cochlear implant that stimulates the nerve of

hearing. Of course, this kind of hearing assistive technology varies by age and the type of hearing impairment, in which a professional audiologist authorizes.

Although first, the child must attend therapy speech sessions, in which this field had been exposed to different therapeutic approaches in order to improved pronunciation and language with hearing impaired group like the toned pronunciation program “Verbotonal” which aims on building vocal abilities, and therefore helps on linguistic development of the hearing impaired patient through training upon the designed device that produces various tones.

With other treatment like the case study of Dorman 1999 aside, there is the auditory-verbal therapy that aims on growing listening skills and mainly focuses on listening which later on results into natural growth in both speech and language, whereas the results of this study indicated on its highly effectiveness and importance.

Walzman 1994 study with the title of “the effectiveness of the oral language training growth in children with hearing loss” aimed to identify the extent of improvement that hearing-impaired children achieved after the oral language training, in which later on concluded that these children fulfilled high levels of using language. (Khero, 2015, p. 18)

Rehoades 2001 study with the title of language growth with the auditory verbal approach for children with significant hearing loss. The results found the effectiveness of auditory-oral technique when it comes to discrimination of different sounds. (Khero, 2015, p. 15)

Through the mentioned above, it is clear to us that the majority of studies deliberately followed classical methods to improve language of children suffering from hearing impairment, and with the latter, we will attempt to follow a technique that is dependent on the role of motor–oral training in sound discrimination. From here, we summarize this study problem to these questions:

- 1- What are the most common types of articulation disorders in the hearing-impaired category?
- 2- What are the hardest sounds from the articulation and auditory discrimination aspects in the hearing-impaired category?
- 3- What is the role of motor training in the improvement of the auditory aspect?

1.3. The goals:

- The identification of the most important speech disorders that is common in the hearing-impaired category.

- The identification of the prominent sounds and morphemes of words that the hearing impaired find difficulty regarding the auditory perception (understand the difference between sounds) and the oral production (articulation).
- Defining the role and location of oral-motor training in the course of treatment specialized in the auditory perception to the hearing disabled.

1.4. The importance:

- It has theoretical and practical great significance considering it's a study that attempts to combine between what is cognitive (auditory discrimination) and oral production (articulation).
- The results may be highly capable of opening the door in front a new study specialized in the hearing impaired division, and that is what will provide sufficient information in order to solve and decode the problematic mysteries surrounding it.
- The results may also benefit in the therapeutic procedures and contributes in designing activities consistent with the disorders that the hearing impaired suffer from.

1.5. Study Terms:

1.5.1. The Hearing impaired with assistive equipment:

They are individuals with diminished sense of hearing more than 34 db and less than 70 db, which makes them in dire need of educational methods to understand speech through the utilization of assistive listening devices, like cochlear implant or other classical equipment (Youssef, 2007, p. 9)

1.5.2. Oral-motor training:

Is a variety of exercises involved in the remedial training directed to articulators and vocal organs, like facial massage, mouth and facial movements, correct breathing techniques intended to create flexibility in the articulatory organs that aids in speech.

1.5.3. Sound discrimination:

It is one of the most important skills that falls beneath auditory perception and means the ability to recognize the intensity and level of sound, as well as its potential to distinguish between the main units of speech (phonemes) and recognize similarities and differences in similar words, plus the production of words with the same tone and intensity, which is considered a significant skill.

1.6. The theoretical aspect of the study:

The field of Otology attracted the interest of numberless researches from several specialties like psychology and medicine and education, and that is why there existed many of definitions. For example, Abdul Hai (1998) defined it as a case that an individual suffers from due to genetic and congenital and environmental acquired factors, which leads to social and psychological effects, and the hearing disability ranges under two important concepts:

1.6.1. Hard of Hearing: defined as the child who have a partial hearing loss and as a result from such can hear sounds on a certain level of volume, as well as speak language according to a certain level that fits the degree of hearing loss. (Eljaualdah, 2012, p. 23)

1.6.2. Deafness: defined it as the deaf person who is incapable of hearing all sounds nor perceive them in the surrounding environment, with the use of hearing aids or without it. (Eljaualdah, 2012, p. 33)

1.7. Table 1: Degree and severity of hearing loss:

Hearing loss	Degree
Normal	-10 to 15
Slight	16 to 25
Mild	26 to 40
moderate	14to 55
Moderately severe	56 to 70
Severe	71 to 90
Profound	91+

Source: (Clark, 1981, pp. 493-500)

2. Types of hearing loss

There are three types of hearing loss. The first, is sensorineural, involves the inner ear or the cochlea, the auditory nerve, or a central neural lesion. The second, conductive hearing loss is caused by the inhibition of sound from, gaining access to the inner ear. This inhibition can be caused by something as simple as an ear canal filled with cerumen, fluid in the middle ear or something complicated such as ossicular chain fixation, the third type of hearing loss, is mixed loss, that is combination of sensorineural and conductive. (peter c, weber MD,Alan j, & klein phd, 1999, p. 125)

With the technological advancement, the damage or impairment of hearing became something that doesn't present a profound risk on the patient cases, because there are technological replacements that are highly capable of compensating the deficiency in the hearing function, like hearing aids that helps amplifying voices through the microphone. As for the second suggestion that is cochlear implant, which is the newest invention, directly stimulates the auditory nerve fibers existent in the cochlea, then sends the collected electrical pulses to different regions of the auditory nerve. Nonetheless, using any kind of audio equipment that is from the mentioned above is not sufficient to evolve the capacities of the child, especially in the linguistic aspect according to many researches indicating that one of the biggest negative effects in the hearing impairment is clearly revealed in the delay in the field of language development and the proper articulation of sounds, which is a result of an infant who doesn't receive the appropriate auditory nutrition in the babbling stage nor the phonetic support from the parents. (Dumant, 1996, pp. 11-13)

As already explained Calvert that common hearing errors in hearing impaired children is not necessarily restricted by the production of phonemes (singular units of sound), but rather due to context plus auditory feedback that effects on the mechanism of the articulation system and creates a sort of dysfunction and randomness and lack of coordination between articulation organs and the uttered sounds. (Tye Murray, 1991, p. 453)

1. We notice in the studies that regarded the articulation characteristics in deaf people that there is an agreement upon the articulation issues where the hearing-impaired child shows (Tyemurray, N). There are hearing deficiency cases in which the hearing impaired children suffers from abnormal articulation mechanisms, most of them do the excessive jaw movement through articulation instead of tongue movement for the reason of shaping and uttering sounds (Tye Murray, 1991, p. 106).
2. The study of 'Levitt & Stromberg' has reached that the phoneme production of the hearing impaired is characterized by immense disruption like substitution and omission of few targeted sounds. (Levitt & Stromberg, 1983, pp. 53-73)
3. The results of the study 'Inken & Koopmans' titled 'The Impact of Lack of Auditory Perception of Speech Sounds when the Insurance of Deaf Children' were that in case of hearing impairment we mark a clear decrease in the discrimination of sounds, the appearance of various articulation errors, and the influence of comprehension due to the absence of the auditory treatment (Khero, 2015, p. 19)

3. Technique to Develop Communication Oral for Hearing Loss:

3.1. Auditory training skill

1. It aims on developing auditory perceptual skills.
2. Improving sound discrimination, especially ones that are similar.
3. Furthermore, the needs for auditory training increases the more hearing impairment degree lessens (Hallahan & Kauffman, 2003, p. 38)

3.2. Oral communication skill

This skill confirms on the verbal models in the environment and takes from speech the main method for the communication process, which includes training and coaching the hearing-impaired individuals of using speech and in return makes them more able to understand it through the lip movement.

3.3. Focuses on the lip movement

Structural technique: Focuses on words more than the lip movement, plus modern methods like auditory-verbal approach, which is a course of treatment that trains the hearing impaired patients on language acquisition and the exploitation of the functional hearing parts of the ear between the hearing aspect in terms of pronunciation and the discrimination of the distinctive features of sounds.

4. Practical Aspect

4.1. Methods and materials

The researcher followed a descriptive curriculum dependant on case study, which is more appropriate and suitable to provide us with a better understanding of the issue at hand and allows us to reach the expected results; the detailed gained information would be valuable for contributing to answering the questions within this research.

4.2. Research limits:

4.2.1. Spatial limit of study: The location of the study was performed in a private clinic – **The Orthophonic Clinic of Amel**, in **Merouana town**, 01 November Street, Batna state.

4.2.2. Time limits of study: From 21 August 2021 to 04 December 2021.

- The sessions were conducted three times per week, each for one hour.
- Two sessions were administrated by a specialist (individual session).

- One session was a group one.

4.3. Community and sample of the study:

4.3.1. Community of the study: The study community is composed of hearing impaired individuals with hearing aids (Classical electronic device + cochlear implant).

4.3.2. Sample of the study: The research sample study consists of **two hearing impaired cases**—first of cochlear implantation (CI) and the second of hearing aid (a small electronic device that fits in the ear or behind it).

Table 2: The table below represents the characteristics of the study sample:

Cases	Age	Gender	Cause of impairment	Discovery of impairment	Type of equipment	Treatment period (duration)
Case No.1	09	Male	Genetic (Hereditary)	At childbirth	Cochlear implant	5 years
Case No.2	08	Male	Meningitis	4 years	Hearing aid	4 years

Source: D. bousabta yamina

4.4. Study Tools:

In order to achieve the objectives of the study, we used a test known as ‘Teep’ in the Algerian version, An adapted test by **D. bousabta yamina**, which allows us to test and assesse the cognitive abilities in children with cochlear implant between the age of 2 to 10 years. Even more, we also relied on a panel of integration of audio-visual information that grants us the ability to measure and evaluate the special capacities by discriminating between sounds.

5. Procedure of the application:

- The specialist pronounces slowly and clearly three similar words in vocalization whilst displaying pictures representing them. Then, the child would attempt to read the movement of lips and say the words back, in which the specialist notes them down, regardless if they were spoken correctly or not.
- We perform the same previous activity. However, the only difference is that in this one, the child focuses on the hearing rather than reading the lip movement, then we note down the words the way they are spoken.

- When it comes to the articulation errors, we do the analysis using the technique of Francois Estienne:

$$(\text{Number of false words} / \text{Number of correct words}) \times 100$$

5.1. Study method:

We test the sample through a previous evaluation first, introduce it to teaching activities second, and then redo the evaluation in order to extract results and conclusions about the case study.

5.2. Training sessions:

Split to individual sessions and group sessions.

5.3. Individual Session:

The individual sessions lasts from 35 to 45 minutes. Its goal is to improve the oral-motor skills. The main chapters of treatment consisted of:

- Facial massage for 10 minutes.
- Oral motor exercises for articulation, 10 minutes.
- Facial expression exercises for 15 minutes.

5.4. Group Session:

It included all cases, plus the specialist and the child assistant. Its objective was to play games specialized in the following skills: listening, articulation, verbal imitation and general motor skills. Its duration lasts from one hour to one hour and a half.

6. Results

The results of cases in both the previous and following evaluations obtained from various different clauses (columns), we notice that:

6.1. Case number one (A.S)

In the previous evaluation (measurement) when it comes to the articulation aspect through lip reading, we find the existence of different articulation errors between omission, substitution and addition:

For example:

 Substitution: Kes → Tes

 Deletion: Sif → If

 Addition: Beb → Beben

- The percentage of articulation errors were 60.78%
- As for the results of the auditory cognitive abilities, there is an almost entirely deficit in the process of recognition and the repetition of words, which was

distributed on the first or the last parts of it. Meaning in short, the deficit wasn't precisely based on a clear part of words.

For example:

✚ Lham → Amam.

✚ Tmar → Taàl.

- The percentage of errors in the auditory aspect was 70.58%
- As after the following evaluation of the same case based on the same test, we notice a notable decline on the level of lip reading, becoming altered between omission or distortion, as in articulation of sounds closest to the targeted sounds of words.

For example:

✚ **Substitution:** Beb → Bem.

✚ **Omission:** Lma → Ma.

- The percentage of articulation errors were 37.25%
- The hardest sounds to articulate were the background ones due to their difficulty of being detected; the case is still unable of mastering sounds that requires air.
- The percentage of errors in the cognitive hearing aspect is 56.86%

6.2. Case number two:

We notice in the previous evaluation concerning the articulation aspect (lip reading), the child suffers from articulation disorders between distortion and substitution:

For example:

✚ **Substitution :** Rgel → Lgel

✚ **Distortion :** Mul → Bul

- The percentage of articulation errors were 74.05%
- When it comes to the auditory recognition and discrimination, the errors were distributed between substitution, omission, and addition.

For example:

✚ **Substitution:** Dar → Lar.

✚ **Addition:** Tamar → Tamaral.

✚ **Omission:** Sheb → Heb.

- The percentage of hearing errors: 70.58%
- After training and numerous treatment sessions, we performed an after evaluation and skill measurement to the case, and from the results, there has been a marked improvement when it comes to the articulation aspect (lip

reading), plus the existence of distortion in the majority of the child's vocal production,

For example:

✚ Nes → Nez

✚ Hbeb → Abeb

- The percentage of articulation errors 31.37%
- Concerning the hearing aspect in the after evaluation, the results were a slight improvement despite the difficulty in reading and production of words according to the practiced model, and the majority of disorders were addition, substitution and distortion.

For example:

✚ Deletion: Sma → Ma.

✚ Substitution: Hut → Lud.

- The percentage of articulation errors in the cognitive auditory aspect were 58.82%

7. Discussion and Results Analysis according to the case study question

1. According to the case study results in the articulation aspect (lip reading), we notice the prominence of various articulation disorder types (Substitution, addition, deletion and distortion) whereas these kind of types don't occur on permanent basis and always change according to the nature of existent sounds in words, which reflects on the weaknesses of auditory capabilities that also reflects in return on the articulation (for the hearing impaired category). And that is what answers the first question of types of articulation disorder in the hearing impaired category.
2. Regarding the articulation aspect (lip reading) in the after evaluation, we note that the role of oral-motor training contributed greatly in the improvement of the level of speech sound perception through the vocal exit pathway, which what both the former and after measurement results clarify. Furthermore, we mark a decrease in the types of articulation disorders, especially in case number two who is equipped of hearing aid. In his situation, we notice the widespread of distortion, in which we mean with it the articulation of sounds that are so similar due to having the same vocal exit pathway. Even more, case number two was constantly present during their programmed treatment sessions and benefited from the early intervention, unlike case number one who wasn't particularly involved in an organized manner to the treatment sessions.
3. Regarding the results of articulation aspect (lip reading), we notice difficulties in the suprasegmental level (stress, tone, articulation speed).

However, after the second evaluation, we notice a remarkable improvement of this aspect, especially case number two.

4. Concerning the hearing aspect in the former evaluation, the goal of our case study that aims to enhance this part through the oral-motor training, we mark the incapability to identify and articulate sounds in which the after evaluation evidently shows.
5. In the after evaluation, we don't notice significant improvement in the field of discrimination and identification of sounds in words. Difficulties remain in all cases, expect a slight improvement that could be counted with percentage of case number two compared to case number one and that is due the continuity of attending treatment sessions.

8. Analysis General:

1. The general reading of results show that the capabilities of the hearing impaired is weak, and that is what the prominence of articulation types show in an unstable image where parts of a word `
2. Differentiates than the other and one case differentiates than other cases.
3. The prominence of substitution and addition types or the prominence of substitution + addition + omission types.
4. As for the after evaluation, we notice a remarkable improvement in 'lip reading' and that is due to the dependence on the technique of motor training that contributed on the 'lip reading' skill as well as the identification of sounds through the perception of exit pathways, in which we notice the eminence of distortion type that causes the articulation of sounds similar and close to the targeted ones. Here the oral-motor training becomes significant in the improvement of sounds according to the methods and techniques that is based on lip reading in the treatment protocol. We also notice that massive exposure and taking advantage of the early intervention has a great role in the improvement of articulation on the long term, given that the results of case number two is far superior compared to the results of case number one. In addition to that, the type of hearing aids is not enough if the child isn't exposed to early intervention and support from specialists that aim to enhance the main skills that the hearing impaired category lack or find difficulty in (weakness and deficiency).
5. As for the auditory perception (sound discrimination), the results were that the adopted method of oral-motor training didn't fail the expected outcome, whereas the improvement was as clarified in the articulation aspect (lip reading). From here, it can be derived that the oral-motor training is very important in the treatment plans directed to the hearing impaired, except that

the oral-motor training is drawn after the method that depends on the improvement of auditory perception part and that is for the purpose of growing the most needed hearing capabilities skills.

9. Conclusion:

The study has covered an important topic in the field of the hearing impairment whereas the goal of it is to verify the role of oral-motor training in the discrimination of sounds to the equipped hearing impaired, and through the field gathered data we have concluded that the hearing impaired category actually suffers from articulation disorders (Omission, Substitution, Addition, and Distortion).

The treatment that initially depends on the motor training doesn't aid in the growth of audio capabilities, but rather, contributes in the improvement of the articulation aspect, especially to cases that are dependent on lip reading plus the significance of early exposure to hearing aids and speech-language therapy that greatly helps in the auditory improvements, in which reflects on the performance and productiveness of the articulation aspect.

Through the results of the case study, we proposed a group of activities that helps in encouraging these kind of researches in the field of language and speech in the hearing impaired:

- The importance of early assistive listening equipment and the exposure to speech-language therapy.
- The importance of concentration upon the audio configuration as well as upon the growth of special capabilities in the auditory perception.
- Directing researches toward the advancement of used techniques in the field of language and the refinement of articulation of the hearing impaired and taking advantage of this kind of technology.
- The importance of the incorporation of parents in the treatment schedules which will later on reflect positively on the cases.
- The necessity of cooperation of speech-language specialists and audio assistants and audiologists in the improvements of the deficient articulation capabilities of a hearing impaired child.

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