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Diagnostic technologies and rehabilitation systems for chronic aural and oral communication hysteresis

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Introduction & problem formulation

Utilizing evolving technologies for the therapy of severe dysfunctions has been a notable highlight for the otorhinolaryngological medical practice recently. In the field of aural and oral communication notable achievementss[1] include advanced Hearing Aids, or, occasionally, prosthetics, coupled with mobile devices for better regulation and interfacing, radio-electronic appliances that create a bionic environment with apparent tendencies for virtualization, and, above all, Cochlear Implants.[2]

For all these devices, and especially for the Cochlear Implants, being by far the most expensive interfaces of these kind, their users are subject to post operational adjustments aiming to regulate the acoustic characteristics of the recipient's hearing via mapping functions. Usually they are held in sessions at the hospital's premises, or, alternatively, via remote fitting sessions.[3] In most cases, therapeutic interventions are accompanied by linguistic course treatments premeditated to reverse the physical or mental debilitating operative handicap of severe hearing loss.[4]

When a young patient does not hear well, the formation of qualities that facilitate the achievement of adequate oral communication, proper use of language and companionship incidental to social skills is markedly restricted. To remedy this causal relationship, the patient's cognitive development has to be further improved by amplifying and supplementing his or hers residual acoustic basis; the same time, inclusive pedagogy should be offered in his or hers early settings or as part of his or hers primary school education, providing activities that impart knowledge and social skills when classroom teaching is failing to be rewarding.

In the particular situation where an adequate magnitude of speech and language communication may not be attained, the patients seem not to be conforming to accepted notions of the so called "social intelligence" qualities for the exchange of information between peers or the pedagogue. Therefore, within the premises of a Cochlear Implantation Unit, a counseling team of Speech Communication experts, cooperative with the medical personnel and the family of the patients, seeks to affect many developing physical or mental conditions that are limiting the patients senses, movements and learning activities. Preemptive re-enforcement for the developing capabilities is needed, before dysfunctions become apparently manifested and it is too late to cope with them effectively.

For the most part, impaired in hearing patients, having obvious problems with the faculty by which major senses perceive external stimuli, develop issues with their phonological processing. What occurs as a predictable consequence is that although such patients receive under normal circumstances adequate schooling, they become ineffective, in most cases, to timely process writing skills or develop oral communication at satisfactory levels. In certain occasions, if a series of neurophysiological disorders may pile up, alongside other social surroundings unwelcome situations, patients develop difficulties in learning to read, to interpret coherent letters, to combine other related symbols. Overall, there is a reduced ability to comprehend written words. Moreover, if impairments have not an early diagnosis and cure, in the field of mental growth and advancement psychological implications evolve, and linguistic rehabilitation becomes a long term priority; sometimes, in severe cases mostly, patients have to drop out of normal schooling institutions and their training is serviced in special education facilities.

The spearhead of contemporary Medical Technology provides two important tools, the programmable digital Hearing Aids and the Cochlear Implants. Their industrial production has changed effectively the education of deaf and hard in hearing children worldwide. Hearing impairments are quite common in our times, raising, as expected, the issue of a marketable trend in biomedical technology. It should be noted, however, that this drift has not reached this extent due to congenital causes and harsh to the senses environmental factors, but, mainly, due to the increased technological forecasting in the field of medical diagnoses. Cochlear implants are also wide spread, but their cost has confined their massive usage virtually to First World countries.[6]

Hearing loss is one of the commonest reasons to visit an Otolaryngology Department both in the clinic and in the acute setting. With the use of prolonged statistical inference methods and practice it has been estimated[1,5] that nearly 15% of American adults, aged 18 and over, face malfunction in hearing. As Unites States have pioneered in promoting standard hearing examinations to schooling premises, it has been found that one in eight people aged 12 years or older has developed hearing loss in both ears. In age-related surveys it has been found that around 2% of adults, aged between 45 and 54, are facing disabling hearing loss. In the next age zone, that of 55-64, this figure increases to 8.5%. As most people in First World countries have increased considerably their life span, contrasted to their Third World counterparts, in the age zone of 65 to 74 an up climb of 25% is recorded. What is alarming, though, for quality of life reasons, is the percentage of those who are 75 and older: some 50% of the population in this group is burdened with a disabling hearing loss.

These figures, albeit drawn from USA, portray a tendency in a world wide perspective: older people, apart from having disabilities of a specified kind are constricted in their social activity and behaviorism. In First-World countries, where national health systems are quite effective, it is very important to have an early diagnosis, as hearing loss or deafness are far more critical when they occur in pre-school age[5,7]. If for older people hearing loss may by annoying, for very young patients congenital hearing loss and deafness could prove to be destructive. The increased potential for an early diagnosis and the concomitant cure is preventing the development of dyslexia and other pre-lingual disorders that impede embodiment to normal schooling institutions. Under such conditions, speech communication develops linearly for the official language discourse of most countries (Figure 1).[7,8]

Figure 1 Calibration, fitting and speech therapy counseling at the AHEPA University Hospital Cochlear implantation unit with patients that have virtually heard for the first time in their life (summer 2025).

Overall, Cochlear Implants have boosted their users' performance to higher levels than those achieved for language acquisition by conventional Hearing Aids. However, as young students learn not only by vigorously participating in activities of their normal schooling context but from engagement in energetic pursuits like watching TV and Internet broadcasts, or by participating in sociable entertainment, a new way to foster Speech Communication modalities has emerged.

As seen in Figure 1, right, aural and oral communication disorders may be become eminent, with apparent cause, in full age as well.[9] Such is the case of adult patient M.B., aged 30, who adventurously arrived in Greece from war-stricken Syria 5 years ago. Having serious hearing disorders diagnosed from early age, due to the harsh social and economic living conditions in his Middle East social habitat, he could neither receive recompense from health services nor adequate guidance in his learning processes. As a result, he did not develop oral communication skills and interacted with his social environment using sign languages and lip reading.

From the age of 6, having being diagnosed with congenital bilateral hearing loss that was deteriorating, he was directed to use Hearing Aids; nevertheless, they were of little help. Living and working currently in Thessaloniki, he visited the AHEPA University Hospital ENT clinic on February 2, 2025. From audiological clinical examinations (Evoked Auditory Brainstem Responses, analytic Audiograms and Otoacoustic Emission Test measures) he was diagnosed with bilateral sensorineural hearing loss > 110 dBHL, bordering on deafness.

The use of a powerful Hearing Aid, applied on his night ear (RE), did not improve his hearing or his communication potential; therefore, he was queued for Cochlear Implantation. He was operated on the right ear on July 2, 2025. His post-surgical audiogram (RE) is 30 dBHL. Indeed, a highly improvable accomplishment for his aural communication potential.

Asked to portray his hearing experience, he explained somehow that for the first time he has been able to recognize voices, which prior to implantation, with the normal Hearing Aids was fuzzy, cartoonish and at best similar to a noisy street.

Interestingly, after the recent spectacular technological advances in the ENT field, training tools and methods are required to improve speech recognition, speech production and speech intelligibility. Patient M.B. does not have many acoustic memories of his mother tongue, and living in a European country he seeks speech intelligibility and oral communication development. Nevertheless, at his age there are not many, if any, obvious options for schooling where he would practice linguistic competencies of some kind.

Conclusions and future trends

Albeit not very common, the case of adult patients needing urgently non-formal linguistic training, alongside other groups of people, increases alarmingly. As institutionalized education seems not to be an option, Computer Assisted Training tools and methodologies able to meet maturing obligations, assets in excess of dysfunctional liabilities and advanced interactivity are sought.

The research team of the AHEPA University Cochlear Implantation Unit is seeking Computer Assisted Training solutions offering immediate feedback and personalized instruction.

Some sort of Educational TV with Internet Interactivity is needed, broadcasting programs for information and education on linguistic communication. Furthermore, protocols and standards ameliorating performance in this field for linguistic profiling and increased efficiency have to be introduced.

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Conflict of interest

No conflict of interest exists.

References

1. National Institute on deafness and other communication disorders (NIDCD), 2025.
2. Stagiopoulos P, Politis D, Kyriafinis G, and Tsalighopoulos M. From hearing aids, prostheses and cochlear implants to "Bionic" Feedback Phonation. *Int Journal of Engineering Research and Application (IJERA)*. 2016; 6(8):119–138.
3. Kyriafinis G, and Chriskos P. Cochlear programming through the internet. In: Politis D, Tsalighopoulos M, Iglezakis I editors. *Digital Tools for Computer Music Production & Distribution.* IGI Global, Hershey: PA; 2016. p. 24–40.
4. Politis D, Kyriafinis G, Aidona S, et al. AI assisted multimedia learning protocols: the cases of special education for the impaired in hearing and music learning for chanting. *International Robotics & Automation Journal.* 2018;4(4).
5. Stagiopoulos P, Kyriafinis G, Aidona S, et al. Evaluating the linguistic abilities of impaired in hearing children – Macro Level Competences Vs Personalized Development. *International Journal of Current Research.* 2017;9(05):51098–51112.
6. Jesuyajolu D, Obuh O, Edeh E. Overcoming developing–world challenges in cochlear implantation: A Nigerian perspective. *Ann Med Surg* (Lond). 2023;85(11):5533–5537.

7. Holt R, Kirk K. Speech and language development in cognitively delayed children with cochlear implants. *Ear & Hearing*. 2005;26(2):132–148.

8. Liao EN, Yaramala N, Coulthurst S, et al. Impact of sociodemographic disparities on language outcomes after cochlear implantation in a diverse pediatric cohort. *Otolaryngol Head Neck Surg.* 2023;168:1185–1196.

9. Johns Hopkins Medicine – Adult cochlear implant: Carol's Story. 2025.

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