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Dental aspects of hearing impairment in children – aetiology, classifications, diagnostic programmes, rehabilitation. A literature review

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Summary

A literature review was performed to present the epidemiology of hearing impairment both worldwide and in Poland. Pre-and postnatal risk factors were assessed. The paper presents classifications of hearing impairment considering different factors, as well as the method of neonatal hearing screening in Poland. Diagnostic, therapeutic and rehabilitation methods for patients with hearing loss were described. The work draws attention to the psychological aspect of the development of children with hearing impairment. The oral health in deaf and hardly hearing children in Poland and worldwide, as well as implications of hearing impairment on the masticatory organ were described. Several factors, such as insufficient hygiene, contribute to high caries frequency and gingivitis in children with hearing impairment. Missing or malformed teeth, and malocclusion pose a great challenge for dentists.

Hearing loss is the most common disability in children. Difficult communication is a barrier during dental visit, and the poor understanding of information provided by medical professionals prevents oral health improvement. Appropriate training and modification of the educational methods used would contribute to better outcomes.

The aim of the paper was to present dental aspects in patients with hearing impairment, as well as to draw attention to the poor oral health in these patients compared to healthy individuals.

PubMed and Researchgate databases (2004-2017) were analysed. Also, some of the websites related to the issue of hearing impairment were included in the analysis.

Epidemiology

Hearing impairment affects about 10-15% of world's population, which is about 500 million people. It is estimated that about 440 million children globally are affected by hearing impairment of more than 85 decibels (1). Hearing impairment is the most common congenital defect

in Poland. The 2003-2006 screening of 96.3% of Polish newborns showed hearing impairment of a varying degree in 0.18%, profound hearing impairment in 0.02%, and sensorineural hearing loss in 0.11% of children (2). However, a screening conducted between 2003 and 2013 showed a higher proportion of children with hearing impairment – 0.3% (3). Deafness and profound hearing loss affect 0.1 and 1% of Polish children, respectively (4). More than 15% of school children experience hearing problems, which most often result from complications after upper respiratory infections. In Poland, 80% of people with hearing impairment do not wear hearing aids (5-9) although it is repeatedly emphasised that the use of modern solutions in the rehabilitation of hearing dysfunctions significantly improves the comfort of life in these patients (4, 10).

In 2011, Poland was the first of 9 coutries in the world to conduct the Universal Neonatal Hearing Screening Program (PUNHSP) developed by the Great Orchestra of Christmas Charity in cooperation with the Polish Society of Otolaryngologists and Head and Neck Surgeons and the Polish Society of Neonatology. Currently, the programme is coordinated by the Screening Laboratory at the Department of Otolaryngology and Laryngeal Oncology at the Poznan University of Medical Sciences, and the Professor Witold Szyfner, MD, PhD is the Medical Coordinator (11).

Stage I screening disqualifies about 91% of neonates for hearing loss. A retrospective analysis of risk factors among second reference level children demonstrated risk factors in 86.61% of children with positive reference 1 results (3). The programme provides unambiguous results, which allow drawing epidemiological conclusions and provide guidance for planning healthcare expenditures (3, 12, 13). Of the about 8.5% of screened children requiring continued diagnosis, about 55.8% are reported for further testing (3).

Risk factors

Table 1 summarises the most common risk factors for hearing impairment based on literature data. The cause of hearing loss remians unexplained in about 40-50% of patients (13).

There is a correlation between profound hearing loss and the presence of at least two risk factors (21).

Classification

Depending on the factors, the most common classifications of hearing impairment are based on various criteria:

- the onset (pre-lingual, peri-lingual, post-lingual hearing loss),
- location (peripheral, mixed, central),
- aetiology (congenital, acquired),
- severity and extent of hearing loss.

Hearing loss is classified depending on its severity and may be mild (21-40 dB), moderate (41-70dB), an profound (more than 91dB), according to BIAP classification (the International Bureau for Audiophonology) (22).

Tab. 1. Risk factors for hearing impairment (14-20)

- genetic factors: *GJB2* mutations in 50-60% of cases
- infectious diseases: toxoplasmosis, rubella, herpes, cytomegaly
- pregnancy: concomitant systemic diseases, living conditions, education, stimulants, stress
- perinatal factors: hyperbilirubinaemia (71.51%), prematurity (63.25%), ototoxic drugs (62.11%), low Apgar score, low birth weight
- recurrent disorders in the sound conduction system
- chronic exudative otitis media
- injuries
- other factors (8%)

Diagnosis and treatment

Brainstem auditory evoked potentials (BAEPs) and otoacoustic emission (OAE) are used in the diagnosis. The results of these test are the basis for the diagnosis of hearing impairment (22, 24). Pure Tone Audiometry (PTA) is used to assess hearing threshold levels, and allows determining the type and severity of hearing loss. Impedance audiometry detects tympanic membrane vibrations induced by the incoming sound (4).

Cochlear implants are used in cases when hearing aids are insufficient. The use of FM systems in children improves language development and mental health (4, 12, 13).

There is a correlation between mental disorders in children and hearing impairment (13). Currently, about 3-10% of children present with delayed speech development, which is due to hearing loss of varying severity (25), and insufficient psychological support for the hearing parents of deaf children in 1/3 of these patients (26).

Currently, there are 32 educational institutions for children with deafness and hearing impairment in Poland. Insufficient system of early intervention in Poland, support limited to medical assistance and the lack of appropriate support system for families lead to difficulties in adapting to the environment (4, 5).

Dental aspect

A hearing-impaired dental patient requires particular attention due to difficult communication with both the dentist and dental assistant. The inability to fully understand the information provided results in insufficient hygienisation performed by the children themselves and their relatives, which consequently leads to poor oral health. Higher frequency of caries results from the limited knowledge on hygiene, prevention and diet among parents and caregivers in special schools (27-29). Jain et al. (29) estimated permanent dental caries index (DMFT) at 2.61 in children with hearing impairment and 0.9 in controls. The frequency of caries was 93.33% in the study group and 88.37% in the control group. Another study among children with different types of hearing defect showed caries frequency of 95.7% (DMFT 0.87) in

Tab. 2. Oral health disturbances in certain syndromes involving hearing loss (36-41)

Osteogenesis imperfecta	Dentinogenesis imperfecta
Usher syndrome	impacted teeth, enamel hypoplasia, thin enamel in radiography, dental discolouration
Waardenburg syndrome	dental agenesis, conical teeth, taurodontism, cleft lip and palate, malocclusions
Neurofibromatosis	maxillary hypertrophy, spacing of teeth, class III skeletal relation, impacted and supernumerary teeth, abnormal dental structure, gingival and lingual papillae hypertrophy
Albers-Schönberg disease	dental anomalies, odontomas, maxillary osteomyelitis, impacted/deformed teeth, hypodontia, high arched palate, loss of periodontal ligament apparatus with chronic periodontitis

the group of 6-7-year-olds and 93% (DMFT 5.12) in 11-12-year-olds; dmft – 7.35 and 4.45 in the control group (30). Avasthi et al. (31) showed caries frequency of 72.43% (DMFT 3.18) in children with hearing impairment. Malocclusions were observed in 57.98% of children affected by hearing impairment. According to Gross (32), dysfunction of the tongue and the orbicularis oris muscle is one of the causes of maxillary narrowing in patients with hearing loss. It was also observed that the prevalence of periodontitis is more common in patients with hearing impairment (33).

According to the guidelines of the American Academy of Pediatric Dentistry, children with disabilities should be provided with special dental care (34).

Recent reports point to the impact of stomatognathic abnormalities on both acoustic symptoms and hearing dysfunction. In the case of symptoms such as subjective tinnitus, headaches and masticatory muscle or temporomandibular symptoms, audiological, dental, neurological and psychological aspects should be considered in the diagnosis and treatment (35). Therefore, it seems advisable to conduct studies assessing oral health in children with hearig impairment and attempt to determine whether there is a relationship between temporomandibular abnormalities and hearing loss.

Dental and periodontal structural anomalies are found in many disease syndromes associated with hearing impairment (tab. 2).

Hearing loss is also a barrier to communication during dental visits. Depending on the grade of hearing loss, the patient requires longer-lasting visits, as well as dentist's and assistant's understanding and patience. Difficulty understanding information provided often generates the need for the presence of an interpreter or training of the personnel, as well as featuring dentist's office with appropriate educational aids adjusted to patients with hearing loss, such as diagrams and hygiene instructions in a graphic form. In the case of concomitant intellectual disability, performing procedures under general anaesthesia is often contemplated.

Conclusions

Hearing impairment is the most common disability in children. It is the reason for limited access to education and lower quality of life. Dental patient with hearing impairment requires particular attention due to difficult communication, which is a barrier to understanding information provided in a dental office. Therefore, medical personnel should be trained in both sign language and the way dental visits are conducted by modifying both the methods used for providing instructions and educational aids. There are a number of cases where only assistance in the form of an interpreter ensures appropriate contact with a hearing-impaired patient. Devoting an appropriate amount of time for the visit and a large dose of empathy would contribute to better understanding of the patient and, consequently, improved oral health in hearing-impaired children, as well as reduced number of procedures performed under general anaesthesia.

Conflict of interest

None

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