

Impact of physiotherapy in auditory processing disorders in children with autism spectrum

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Abstract

Background: Auditory processing disorders (APDs) are characterised by impaired recognition and interpretation of sounds from the external environment.

Methods: The study involved 34 boys aged 4-9 years diagnosed with autism attending physiotherapy at the National Autism Society of Kielce. The study was based on observation regarding disorders of the auditory system. Clinical observation and standardized questionnaire of sensorimotor disorders were used prior to and 6 months after treatment. Moreover, the study benefited from the classical and adaptive test of speech understanding.

Results: The children with autism included in the study had problems with auditory hypersensitivity, difficulties in understanding verbal commands and focusing attention in noise.

Conclusion: Physiotherapy in children with autism spectrum disorders reduces auditory hypersensitivity, improves understanding of verbal commands and focusing in noise.

Key words: auditory processing, autism, sensory integration, physiotherapy

Introduction

The brain starts receiving human speech from the fourth month of the foetal life. The first three years of life are essential for the development of hearing and speech intelligibility. During the first year of life, the child's brain develops the ripening processes that affect mastery of individual speech. The period between 6 months and 2 years determines the development of speech. The properly developed hearing system is necessary to master linguistic forms and to develop inner speech, which is the basis of the process of thinking [1]. Increased sensory stimulation of modern civilization leads to a number of dangers in the functioning and development of senses of young children. The external environment is degraded acoustically. From an early age, children are exposed to toys and devices that sound too loud; therefore, processing problems may occur. Children who are raised in environments poor in acoustic stimuli

are also at risk of hearing impairment [2]. Verbal communication improves the ability to focus attention on longer speeches and to understand their content, teaches formulation of thoughts and improves interpretation of emotional expressions [3]. Sensory disorders can lead to abnormal processing of acoustic stimuli at the neuronal level not resulting from cognitive and language impairment.

Incorrect processing of hearing stimuli in children with autism spectrum disorders results in difficulty in recognizing, discriminating, separating, segregating, and localizing sounds from the environment despite the absence of hearing loss [4,5]. Children with autism can however suffer from hearing loss due to slight hearing impairments in the peripheral auditory system, e.g. resulting from chronic otitis media. In such cases, despite the restoration of proper hearing sensitivity, children will continue to experience

difficulties in understanding speech during noise, despite restoration of proper hearing sensitivity. The disturbed processing of auditory information attenuates recognition and interpretation of sounds coming from the external environment [6,7]. According to the research conducted in 2008 by the Institute of Physiology and Hearing Pathology, the problem of improper integration of sensory adjustments of the hearing system affects on average 2-3% of children without hearing impairments. In Poland it is estimated that 5-7% of children aged 7-14 years have problems with proper processing of auditory stimuli. Central auditory processing disorders (CAPDs) are the conditions of impaired auditory function caused by the central nervous system (CNS) [8]. The diagnostic criteria for CAPD include: 1) disturbed localization, differentiation or recognition of sounds; 2) impaired temporal aspects of auditory signals; 3) lack of speech or speech in the presence of a jamming signal and competitor signals. The causes of CAPD are neuromorphic damage, neuronal developmental delay, c) post-traumatic injury, d) long-term peripheral hearing impairment [9,10]. Impaired hearing in children with ASDs contributes to difficulties in using the audible signal when the reception in the peripheral structure is normal. An acoustic stimulus from the external environment is recognized by the hearing organs, converted to sensory information, which is interpreted by the brain in the following sequence -acoustic stimulus-brain-midbrain-auditory cortex. The regulatory process of impaired hearing involves discriminatory sensory modulation. Children with ACDs diagnosed with hearing difficulties often need visual information to understand the acoustic stimulus. Difficulties associated with impaired auditory processing may be a barrier to normal development of the child [11,12]. This condition may manifest as problems in recognizing the differences between sounds despite a well-developed auditory system, where difficulties arise

when there is background noise. Children with ASDs may experience speech delays, attention deficit disorders, anxiety and dizziness. Moreover, difficulties in learning are likely to occur as ASD children are often chaotic, forgetful, and have spelling problems [13,14]. Furthermore, hearing difficulties may be observed, due to inability to select auditory stimuli. Dysfunctional processes of integration of hearing impulses can be divided into hypersensitivity and subtlety. Hypersensitivity modulation disorders can be manifested as escape from loud sound, ear clogging, excessive fear of crowds, avoidance of ear washing, listening to the sounds of autostimulation, difficulties in falling asleep, and sleep problems. Auditory hypersensitivity due to sudden loud sounds may be a form of auditory phobia that is aroused by fear of unforeseen auditory disturbances (loud alarm) [15]. On the other hand, hearing-impaired children show excessive listening to noise, loud noises, striking or shattering of objects, applying earpieces to vibrating objects, listening to loud noises, [16,17].

Nearly neuronatomic location of the auditory, visual, and atrial system may lead to dysfunctions of the auditory and auditory-visual components, manifesting a short-sighted auditory-visual memory, blurred speech, difficulty in understanding words, too loud or too quiet speech, graphomotor disorders, difficulty in understanding and remembering sequential commands and motor coordination problems [18].

The aim of the article is to assess the impact of physiotherapy on the occurrence of auditory processing disorders in children with the autism spectrum disorders.

Materials and method

Thirty-four boys aged 4-9 years diagnosed with autism spectrum disorders were enrolled to the study conducted from April to October 2016 at

the National Autism Society (NAS) facility. The tests were performed before the physiotherapeutic treatment and 6 months after it to verify the results. The inclusion criterion was the diagnosis of overall autism spectrum disorder whereas the exclusion criterion was the diagnosis of hearing loss. The study groups consisted of children communicating through active speech. The study was based on observations aimed at collecting data on impaired auditory processing. The following was taken into account: presence of a reaction to the name, the child's reaction to whispering, screaming, differentiating the consequences of sounds, types of preferred sounds, and the frequency tolerance range. The diagnostic procedures also included the occurrence of synesthesia and the ability to synchronize sounds with another person's voice. The Questionnaire of Sensorimotor Disorders and the Clinical Observation Test, standardized for therapists of the Sensory Integration Method, were applied. The study was carried out in accordance with ethical principles, i.e. with the written informed consent of parents. The study also used a classical and adaptive speech impedance test, which demonstrates the percentage of correctly understood words and determines the signal-to-noise ratio (SNR).

The children tested for 6 months attended physiotherapy classes. Each child had an individualized approach to physiotherapy for hearing impaired modulation. Physiotherapeutic treatment was aimed at developing hearing capabilities through appropriate deficit-specific trainings. In children diagnosed with hypersensitivity, physiotherapy was aimed at minimizing anxiety before the effects of acoustic stimuli. The physiotherapist warned the child in advance of the possibility of noise, he whispered to the child. Therapeutic and rehabilitative treatment was to provide the child with the right amount of auditory stimulation through signalling the

appearance of sound, learning how to respond to sounds from the environment, and learning how to recognize them. The physiotherapeutic classes in children with hypersensitivity were based on training in hearing, linguistic cortex stimulation, and identification of variable rhythmic structures. In children diagnosed with hearing sensitivity, physiotherapeutic treatment aimed at stimulating the child with acoustic stimuli. For this purpose, clear, well-ordered auditory stimulation was used, sharp, loud noises were introduced, and acoustic entertainment was provided in acoustic rooms. There were also intensity-dependent sounds, from the loudest to the most delicate. On the other hand, children with ASD diagnosed with sub-acute auditory processing disorders used non-rational, often repetitive sounds, and learned the location of acoustic stimuli. The physiotherapeutic procedures in both hyper- and hyposensitivity were also based on atrial stimulation (swing, rotation), performed auditory processing exercises.

Results

The pre-physiotherapy data showed that 20 (59%) children with ASD had the greatest difficulties focusing attention in noisy rooms. Moreover, 16 (47%) children were demonstrated to have hyperactivity to stimuli and difficulties in understanding the sense of verbal commands (Fig.1).

The results regarding the sensory profile of auditory processing revealed that approximately half of children showed hypersensitive hearing impairments. Correct auditory processing was found in 8 (24%) children (table

After 6 months of physiotherapeutic activities, 27% of children overall had improved auditory processing. Improvement in terms of verbal commands and attention in noise was observed in 41% of patients. Moreover, excessive reactions to sounds decreased in 32% of children (fig.2).

The sensory profile observed 6 months after physiotherapy was correct in more than half of children (65%). Only 5 (15%) children were still hypersensitive (table 2).

Discussion

The study results evaluating physiotherapeutic treatment in the group of children with hearing impaired disorders demonstrated improvement in the range of sensory stimulation of acoustic stimuli. Before physiotherapy, half of children showed hypersensitivity features; after 6 months of physiotherapeutic activity, hypersensitivity was observed in only 15% of children. Prior to physiotherapy, more than half (59%) of children had difficulties in concentrating in noise whereas 6 months after treatment such difficulties occurred in 6 children (18%). Likewise, a significant percentage of children (41%) was found to experience difficulties in the sense of verbal instructions. The results reported by I Lin et al. confirm that children with autism spectrum disorders find it difficult to obtain appropriate auditory and visual information in everyday conditions, even though they are not diagnosed with hearing impairment. According to some neurophysiological studies, people with autism show disturbances in the processing of sound modulations [19]. The study by B. Wahn et al. indicates that appropriately selected polysensory stimulation improves auditory processing [20].

The data presented by Watling confirm that supporting auditory perception in people with autism through various forms of acoustic stimulus visualization is a suitable form of therapy [21].

C. Stewart et al. have found that autistic children exhibit atypical sensory responses contributing to impaired reception of stimuli from the external environment [22]. According to A. Szkielkowski et al., auditory processing disorders may be important in the development of correct articulation in children, but may also explain unsatisfactory long-term speech therapy [23]. Physiotherapeutic treatment should be based on adapting the external environment to the needs of children. Observations by G. Chermak et al. show that speech intelligently improves due to intelligently applied traditional hearing trainings. In our study, speech perception in children with impaired auditory processing improved. After the therapy, children were found less fearful, anxious, less depressed, not afraid of making new friendships and conversations [24]. It is extremely important to apply children-tailored trainings.

Conclusion

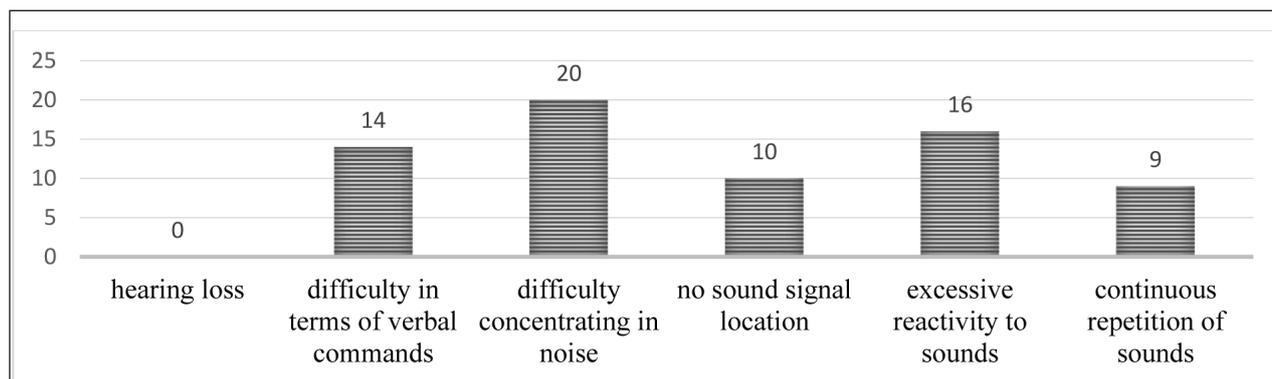
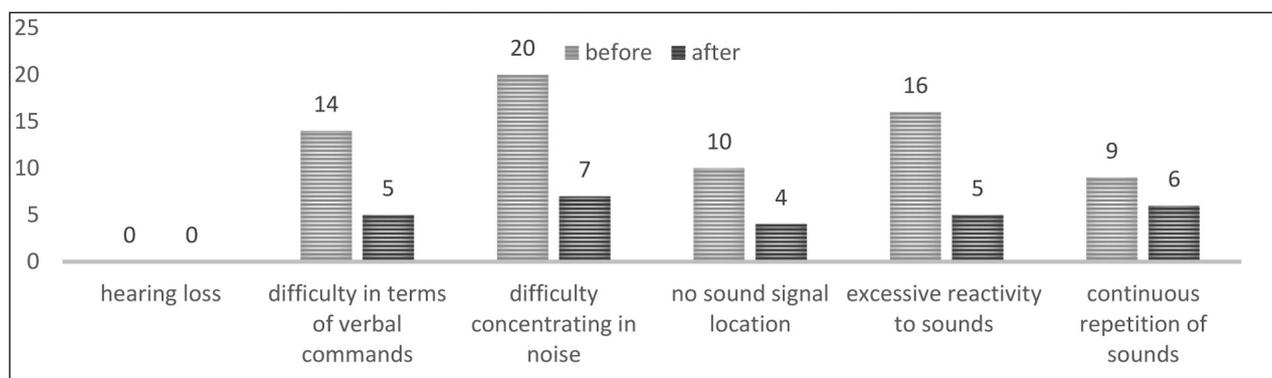
1. Physiotherapy minimises auditory processing disorders in children with autism spectrum disorders.
2. Physiotherapeutic treatment contributes to the reduction of disturbances of sensory regulation of the hypersensitive auditory system.
3. Children who attend physiotherapeutic classes show improvements in focusing attention in noise.
4. Auditory stimulation improves understanding of verbal commands in children with auditory processing disorders.

Table 1: The structure of auditory processing in the studied group of children before physiotherapy

Auditory processing	Number of respondents	
	n	%
Normal	8	24
Hypersensitivity	16	47
Hyposensitivity	10	29

Table 2: The structure of auditory processing in the studied group of children after 6 months of physiotherapy

Auditory processing	Number of respondents	
	n	%
Normal	22	65
Hypersensitivity	5	15
Hyposensitivity	7	20

**Fig. 1:** Sensory analysis of the auditory system in the examined group before physiotherapy**Figure 2:** Sensory analysis of the auditory system in the examined group before and after 6 months of physiotherapy**References:**

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