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Backgrounds of Speech Disorders in Children with Down Syndrome. An Early Logopedic Intervention

Podłoże zaburzeń mowy u dzieci z zespołem Downa. Wczesna interwencja logopedyczna

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Abstract

Speech development of children with a Down syndrome is partly stunted or disturbed in comparison to healthy children's speech, although, it is subjected to the same rules. The right speech development process of children with a Down syndrome (according to a child possibilities) can be provided by a well prepared program focused on stimulation of development and progress of speech in a complex curative and rehabilitative process. The exercises need to lead to the activation of a person and they should help to integrate with a society and, thanks to that, create conditions to the correct personality development. The aim of the study is to identify the causes that interfere with normal speech development of a child with Down syndrome including defects and anomalies in the anatomy and the dysfunction of the central and peripheral nervous system, and to present guidelines for a speech therapist working with a child with trisomy 21 in the first months of life. (JNPN 2016;5(4):162–167)

Key Words: Down syndrome, speech disorders, neurologopedics, therapy for a child

Streszczenie

Rozwój mowy dzieci z Zespołem Downa jest częściej opóźniony lub zaburzony niż rozwój mowy dzieci zdrowych, choć podlega tym samym prawom. Prawidłowy przebieg rozwoju mowy u dzieci z zespołem Downa (na miarę możliwości dziecka) zapewnić może dobrze przygotowany program stymulacji rozwoju i usprawniania mowy w całym kompleksowym działaniu leczniczo-rehabilitacyjnym. Ćwiczenia muszą prowadzić do uaktywnienia się jednostki i pomóc jej w integracji ze środowiskiem, a przez to tworzyć warunki do prawidłowego rozwoju osobowości. Celem pracy jest wskazanie przyczyn, które zaburzają prawidłowy rozwój mowy dziecka z zespołem Downa w tym wady i anomalii w budowie anatomicznej i w dysfunkcji ośrodkowego i obwodowego układu nerwowego, oraz przedstawienie propozycji pracy logopedy z dzieckiem z trisomią 21 w pierwszych miesiącach życia. (PNN 2016;5(4):162–167)

Słowa kluczowe: zespół Downa, zaburzenia językowe, neurologopedia, terapia dziecka

Introduction

Speech disorders occurring after a brain injury have posed a research problem for socio-medical sciences for decades. The interest stems from the enormous role played by the speech in social life and mental development of every person.

Many authors strive to find similarities in the functioning of language and brain saying that the structure of language reflects the human brain activity [1–3]. According to their opinion, speech is one of the most

important effects of the human brain activity. It has a hierarchical organization, there is a fixed sequence of movements of articulation in the pronunciation of words, a rational order of words in a sentence, the order of sentences in the passage, passages in the text. The established order of elements occurs not only in speech, but affects all instrumental activities. It manifests itself even in temporal coordination of muscle contractions in the performance of simple movements, such as reaching or grasping. Therefore, there seems to be a plan underlying

each activity, including speaking, which determines its course of performance [4].

The proper development of speech in children depends on a variety of favorable conditions. Namely: lack of anatomical defects impairing the act of speech, normal psycho-physical development of a child, a family in which a child is raised and the social environment [5,6].

The speech of children with Down syndrome is governed by the same rules as in properly developing children. It is, however, much more delayed and/or deviated. The proper course of language development in children with Down syndrome (depending on a child capabilities) can be provided by a well-designed program to stimulate the development and improvement of speech throughout the comprehensive medical and rehabilitation process from the first days of life. However, it is a common situation that parents who visit a speech therapist with a few-month-old babies with Down syndrome receive incorrect information that it is too early to correct defects or that the therapy at this moment may not be effective and should be postponed [7,8].

Hellbrügge [9] as an expert on the development of a small child, believes that “the best and the only period to promote the ability to speak are the first three years. It is an absolute condition for the proper development of speech, because after the age of four, the parts of brain responsible for speech development achieve maturity.

The aim of the study is to identify the causes that interfere with normal speech development of a child with Down syndrome including defects and anomalies in the anatomy and the dysfunction of the central and peripheral nervous system, and to present guidelines for a speech therapist working with a child with trisomy 21 in the first months of life.

Down Syndrome Phenotype

The early time of creation of chromosomal aberration which impairs the genotype determines that the anomalies in Down syndrome affect almost all organs and systems. Currently, it is estimated that Down syndrome may have 200 anomalies, wherein none of which are present in 100% of cases. Most common 20 to 50 symptoms occur in various combinations [10,11].

The characteristic phenotypic features occurring in every child with Down syndrome allow for clinical diagnosis immediately after birth, even before a genetic test result. These features include: slanting palpebral fissures and the presence of epicanthic eye fold, low nasal bridge, underdevelopment of facial skeleton (mid-face), hypoplastic jaw, hypotonia of the orbicularis oris, zygomatic major and minor and temporal muscle, as

well as the masseter and tongue resulting in lower lip eversion, its hypotension, lowered jaw, open mouth and protruding tongue, which is relatively too big as compared to a small mouth. These abnormalities occur along with open bite, pseudo — an occlusion, abnormal sucking, swallowing and chewing [12,13].

Features such as single (“simian”) palm crease, increased distance between the first and second toes, clinodactyly, poor muscle tone (most noticeable in infants), low-set ears, Brushfield spots on the iris occurring in some individuals help to diagnose this syndrome [14,15].

Down syndrome is frequently characterized by morphological and functional abnormalities of the gastrointestinal tract such as atresia and stenosis of individual segments, anorexia, polyphagia, reduced production of hydrochloric acid, or malabsorption [16–19].

Congenital heart defects, occurring in approximately 50% of patients are the most frequent cause of death, since the compensatory capacities of the cardiovascular system accompanied by frequent pulmonary infections decrease rapidly. Most common defects are ventricular septal defects, atrioventricular canal and defects of mitral and tricuspid valves [16,20,21].

On the basis of clinical observations of untreated children with Down syndrome there were defined two types of individuals with Down syndrome: thyroid type and pituitary type. Less common types are: pigment type, chondrodisplastic type, Turner-type and dystrophic type [22,23].

Brain Structure of Children with Down Syndrome

Morphometric studies of brains of children with Down syndrome after the birth until the age of two showed the reduction of cortical layers in the frontal and temporal lobes and decreased cohesion, especially of II and IV cortical layer with a depletion of neurons by 20–50%, which is reflected in low increase of head circumference and microcephaly [24–26]. The studies also revealed the delayed myelination of nerve tracts in 23% (18 out of 129) of Down syndrome cases, which corresponds to the delayed spontaneous motor activity of children and impaired motor coordination, especially in the first year of life [27,28]. Delayed myelination of U fibers, corticopontine and corticospinal pathways, internal capsule, corpus callosum and the pathways in frontal and temporal lobes, which is common in children with Down syndrome provides explanation for delayed development of statomotoric functions and retention primitive reflexes (Moro reflex, grip reflexes, Galant spinal reflex) until the age of one, or even longer [24].

The Beginnings of Speech Development

The formation of articulatory organs and the development of activities preparing for speaking can be traced in utero. The early period of fetal life is the most important for the formation of reflexes of the main points of the face, crucial for speech development. Their presence is assessed right after birth and is the basis for planning the stimulation [29].

Speech is not an innate ability, the child learns it from the immediate environment, and above all from a mother, through imitation. After birth, a baby begins to use the audio signal. Through shouting, crying, cheerful gurgling a baby expresses the emotional state, contentment and joy, hunger and pain. Babies become familiar with the sounds they make and try to imitate the pitch of sounds made by adults referring to them. At this stage, a baby does not understand the words yet, but they can feel in the intonation or the way of talking the emotional charge or a friendly or hostile attitude of the speaker. In the given structures, the child's brain forms sensory and motor automatisms (stereotypes) creating the potential ability to perform proper articulatory functions that can be freely performed under the supervision of phonemic hearing, formed by the traces of the words heard. With time, they consolidate the senso-moto-audio associations, i.e. associations between feeling the muscle tone of voice organs during the articulation of sounds and hearing the produced sounds [30,31].

The majority of children with Down syndrome initiate actions related to verbalization however speech is hardly understandable or later in life, even slurred. Disturbances in articulatory motoric skills poses a very difficult problem in rehabilitation due to the inherent flaccidity of the muscles, including the mimic, chewing, swallowing muscles and the tongue. Since the articulation of individual sounds depends on the appropriate mobility of the tongue, most of children lisp (due to its size and hypotension). The tongue does not fit in the mouth, hence the different combination of sounds are difficult to understand and require constant self-correction [32].

In the process of improvement, the oro-facial area is the starting point for the speech development since birth [33]. Our own observations shows that children who started the therapy in the first year of life achieve the best articulatory efficiency of the speech organ, while children whose stimulation started later had more problems with swallowing, chewing and biting and proper functioning and activity of the tongue, lips (tongue is frequently located between the teeth). Unfortunately, children who were subjected to stimulation after the fifth year of life, presented previously established pathological patterns of behavior of the whole articulatory

organ, which hindered learning of the correct functioning pattern of this organ. Moreover, the children whose rehabilitation started from the birth were more successful when practicing the correct respiratory track with making a sound on inspiration.

The Impact of Sensory Integration Disorders on Speech Development of Children with Down Syndrome

Therapeutic procedures applied in disorders of sensory integration process are to modify neurological dysfunctions by developing capacity for better perception as well as recalling and performing motor functions, what results in better mastery of all school tasks and any other tasks since better motor skills stimulate and improve the intellectual capacity. The integration of senses is a natural process for most people who take it for granted. The awareness of this pathology occurs when as a result of defects in the sight, hearing, balance, taste, exteroception, touch and proprioception, the brain creates false images about its own body [34,35].

There are described the necessary conditions for the smooth integration process, such as: explicitness of sensory information, undisturbed flow of information, without its distortion, triggering the adequate response, which a child will utilize in an appropriate way.

The correct maturation of sensory integration allows the healthy maturation of the child's body and psyche. Moreover, the proper development of mental and spiritual spheres depends on the integration of sensomotrics and visual and auditory perception as well as the cooperation between autonomic and limbic system responsible for emotions. A healthy newborn has senses "ready" to receive stimuli, the ability for general motor activity and reflex reactions. It is necessary to remember that the perception coming from individual sensory channels and motor activity of the baby are poorly related and develop in the first years of life, however the perception from different sensory channels should provide common information to the brain, which means that no channel should provide information independently of the other senses (cannot be isolated). Combining the information of individual sensory channels starts after birth and gradually improves, mainly in the first 10 years of life [36,37].

It allows the child to achieve increasingly more comprehensive perception and perform better and better adaptation responses. With age, a child gets more and more diverse image of the body and the surrounding world, as well as skills such as self-control, self-esteem, ability to concentrate, lateralization, learning, abstract thinking. Stimulation of senses and stimuli generated during the movement stimulate the formation of

synaptic connections in the cerebral cortex, called neuronal network. The movement of the body, its constantly improving coordination is the basis for the formation of specific and more precise activities [31].

Speech disorders in Down syndrome also have their source in the impairment of perception processes. The correct articulation requires specific movements of the mouth, tongue and lips, what is conditioned by the correct planning of these movements. Children with Down syndrome are generally characterized by delayed speech ability and difficulties in articulation. Speaking requires the use of numerous sensorimotor functions. The ability of speech is often delayed when some section of brain does not function effectively. Sensory integration is an ongoing process; each higher level of integration must be preceded by completion of a lower level of integration. Before a child understands the words, they must integrate the ability to receive sound stimuli and before speaking, they must have a good ability of kinetic-proprioceptive perception [36–38].

According to Ayres [39] the speech development in children with impaired sense of balance is slower, even though the speech when it appears for the first time, is often normal. Pronunciation of words requires all basic sensory systems. Sensory integration dysfunctions in children with Down syndrome are related primarily to the reception and processing of stimuli in a vestibular and proprioceptive system, but one cannot forget that they also include tactile, auditory or visual system.

Children cannot feel exactly where their tongue is and how their lips touch, hence their speech is often incomprehensible. Since the speaking process requires very complex planning of movements resulting from its own internal drive, the sequence of processes must be structured in such a way that the produced sounds form words. A child must make this decision “in their own brain” [40].

Proper articulation requires precise movements of the mouth, tongue and lips, similar to moving of the whole body. Therefore, children with speech disorders often have problems with the coordination of movements and spatial orientation [41].

An Early Logopedic Intervention

The knowledge of pathogens which, in a child with Down syndrome, lead to secondary disorders in the oro-facial area contributed to the creation and application of the oro-facial therapy by Castillo-Morales [42], starting from the second, third month after birth. The therapy is to stimulate the neuromotor points of the face, which increase the mimic and masticatory muscle tone, as well as change the morphology of the child's

face, making it more similar to the mother or father phenotype [43].

Speech therapists, who must be involved in the therapy of a child with Down syndrome as soon as possible, in the first months of life should train a child how to suck and drink, they should also perform oro-facial massages, work on existing sounds and encourage their production, stimulate the glottis by vibration, use fingers to trigger “sucking” and “tongue clicking” sounds. In the following months the therapy should include the massage of the tongue, jaw and lips, stimulate different sounds with vibrations, practice imitation of simple movements and sounds accompanying the action, practice imitation of sounds which close mouth and then practice the differentiation of speech sounds, or conduct dialogues in babbling.

The studies show that early intervention contributes, among others, to obtaining a correct resting position of the tongue, proper muscle tone of the lips, tongue retraction and mouth closure, reduced production of saliva, and improved swallowing manner [44,45].

Summary

The comprehensive treatment and rehabilitation of speech in children with Down syndrome initiated at birth allows to obtain early sensory integration and proper construction of the body schema in the brain. It allows to modify genetic patterns of motor skills, their rehabilitation and gradual incorporation into spontaneous motor skills of a child (in terms of statomotoric functions, grasping and speaking), as well as it allows for better development of intellectual functions, which as we know, are determined by obtaining the skills of interpersonal communication.

The treatment and rehabilitation of a child with Down syndrome must include the rehabilitation of speech, which provides the child with the ability to communicate with the surrounding environment. The therapy should begin as soon as possible. Exercises focused on the development of speech include proper feeding, oro-facial massages and therapeutic exercises of the whole body, stimulating the oro-facial area. The goal of a therapist must be to increase mimic and masticatory muscles tone, change the morphology of the child's face, achieve sensory integration, proper motor skills patterns and work on the development of intellectual functions. Exercises must lead to the activation of the individual and facilitate their integration with the environment, and thus create the conditions for the proper development of personality. To meet the set goals, the interest in the development of speech of a small child shall involve both parents, doctors, speech therapists, teachers and therapists.

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