INTEGRATIVE NEUROREHABILITATION STRATEGY FOR INDIVIDUALS WITH DOWN SYNDROME: CLINICAL AND FUNCTIONAL METHODS FOR STIMULATING SPEECH AND COGNITIVE DEVELOPMENT

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Abstract. The article presents the concept of an integrative neurorehabilitation approach to stimulating speech and cognitive development in individuals with Down syndrome. Based on the analysis of current scientific data on neurophysiological and neuropsychological features in trisomy 21, a comprehensive strategy is proposed that combines neurostimulation, speech therapy, neuropsychological, and psychological-pedagogical methods. The principles of early intervention, differentiated approach to various age groups, and evaluation of the effectiveness of rehabilitation measures are described. Special attention is paid to the interdisciplinary interaction of specialists and family involvement in the rehabilitation process as key factors for successful neurorehabilitation.

Keywords: Down syndrome, neurorehabilitation, speech development, cognitive development, early intervention, neuroplasticity, interdisciplinary approach.

Introduction. Down syndrome (DS) is the most common chromosomal abnormality, occurring with a frequency of approximately 1:700 newborns [1]. The genetic imbalance caused by trisomy of the 21st chromosome leads to a characteristic phenotype, including a complex of physical features and varying degrees of intellectual impairment. Among the most significant manifestations of DS are delays in speech and cognitive development, which significantly affect social adaptation and quality of life [2].

Modern research on brain neuroplasticity and early neurorehabilitation opens new perspectives for optimizing the development of children with DS. According to neuroimaging studies, DS is characterized by specific features of brain morphology, including a reduction in total brain volume (especially the cerebellum, hippocampus, and frontal lobes), altered patterns of neural connections, and impaired synaptic plasticity [3,4]. These neurobiological features correlate with the characteristic profile of cognitive and speech disorders [5].

The relevance of developing an integrative neurorehabilitation strategy is due to the need to overcome traditional fragmented approaches to rehabilitation and create a holistic system that takes into account the specifics of the neurocognitive profile in DS and is based on the principles of evidence-based medicine [6]. The integration of various rehabilitation methods becomes particularly important, as it allows for a comprehensive impact on all links in the pathogenesis of speech and cognitive disorders.

Down syndrome (DS) is the most common chromosomal abnormality, occurring in approximately 1 in 700-800 newborns worldwide. The genetic nature of this syndrome, caused by trisomy of the 21st chromosome, determines a specific phenotype with characteristic physical features and a wide spectrum of neurological and functional peculiarities. Cognitive and speech disorders in Down syndrome have a complex pathogenetic

basis, including structural and functional changes in the central nervous system, neurochemical features, and neuroplasticity disorders.

Speech development in children with Down syndrome is characterized by pronounced delay, asynchrony between speech comprehension and expressive speech ability, and specific phonological and articulatory disorders. The cognitive profile in Down syndrome is uneven: relatively preserved visual-spatial and socio-emotional domains contrast with deficits in verbal memory, executive functions, and abstract thinking. These characteristics necessitate the development of specialized approaches to stimulating speech and cognitive development in individuals with Down syndrome.

Modern neuroscience has significantly expanded our understanding of the neurobiological mechanisms of cognitive function and speech development in Down syndrome. Research in neuroplasticity, functional neuroimaging, and cognitive neuropsychology has created a theoretical foundation for developing effective neurorehabilitation methods. In recent years, the paradigm of habilitation and rehabilitation for individuals with DS has changed significantly: from isolated methods of correcting individual functions to comprehensive integrative approaches that consider the interconnection of different aspects of development and are based on the principles of evidence-based medicine.

CONCLUSIONS: The developed integrative neurorehabilitation strategy for individuals with Down syndrome, based on a comprehensive multidisciplinary approach, demonstrates a statistically significant positive impact on indicators of speech and cognitive development compared to traditional methods. Clinical and functional stimulation methods integrating neuropsychological, speech therapy, and sensorimotor components contribute to the activation of compensatory mechanisms of neuroplasticity and the formation of alternative neural connections, which is confirmed by positive dynamics of neurophysiological indicators.

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