

**FORMATION OF SENSORY INTEGRATION IN PRESCHOOL CHILDREN WITH  
MOTOR ALALIA: A SPEECH THERAPY TECHNOLOGY**

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**Abstract**

Motor alalia is a severe speech disorder characterized by impaired expressive speech caused by dysfunction of cortical speech-motor areas. In many cases, this disorder is accompanied by disturbances in sensory processing and motor coordination, which complicates the formation of stable speech skills in children. The purpose of this study was to develop and evaluate a technology for the formation of sensory integration in preschool children with motor alalia within the framework of corrective speech therapy intervention.

The study involved 40 preschool children aged 4–6 years diagnosed with motor alalia. The participants were divided into experimental and control groups. The experimental group participated in a sensory integration–based intervention program integrated into speech therapy sessions for three months, while the control group received traditional speech therapy methods. Diagnostic assessments were conducted before and after the intervention to evaluate indicators of speech development and sensory integration abilities.

The results showed that children in the experimental group demonstrated significant improvement in articulation coordination, vocabulary development, motor coordination, sensory responsiveness, and the ability to combine speech with motor activity. In comparison, the control group showed moderate progress mainly in articulation skills but less improvement in sensory processing indicators. These findings suggest that the integration of sensory stimulation with speech therapy exercises can significantly enhance the effectiveness of corrective interventions for children with motor alalia.

The study concludes that sensory integration technologies play an important role in improving speech development, motor coordination, and adaptive behavior in preschool children with motor alalia. The implementation of multisensory corrective programs can contribute to more effective speech therapy practices and support the overall development of children with speech disorders.

**Keywords**

motor alalia, sensory integration, speech development, preschool children, speech therapy, sensory processing, motor coordination, corrective pedagogy

**Introduction**



Speech and language development is one of the most important components of early childhood development. Communication skills allow children to interact with their environment, express needs, and develop cognitive and social abilities. However, in some cases speech development may be significantly delayed due to neurological or developmental disorders. One of such disorders is motor alalia, a severe form of speech underdevelopment caused by dysfunction of cortical speech-motor zones in the brain. Motor alalia is characterized by impaired expressive speech despite relatively preserved hearing and intellectual abilities, and it is most often diagnosed during preschool age [1].

Children with motor alalia experience difficulties in forming and coordinating articulatory movements necessary for speech production. These difficulties are often associated not only with speech-motor deficits but also with broader sensory processing disturbances. Research has shown that children with speech disorders frequently exhibit problems in sensory integration, which affects their ability to process and organize sensory information from the environment [2]. Sensory integration refers to the neurological process through which the brain receives, organizes, and interprets sensory stimuli from the body and environment, allowing the individual to respond appropriately to external stimuli [3].

According to the theory proposed by A. Jean Ayres, sensory integration plays a crucial role in the development of motor skills, behavior, and learning processes in children. When the sensory integration system functions inadequately, children may experience difficulties in coordination, attention, speech development, and adaptive behavior. These problems are particularly evident in children with developmental speech disorders such as motor alalia [4].

Recent studies indicate that disturbances in proprioceptive, vestibular, and tactile systems can significantly affect the formation of speech-motor patterns. Since speech production requires precise coordination of multiple muscle groups, sensory feedback mechanisms play an essential role in controlling articulatory movements. Therefore, the development of sensory integration may become an effective component of corrective pedagogical and speech therapy interventions for children with motor alalia [5].

In preschool age, the nervous system demonstrates high neuroplasticity, which creates favorable conditions for corrective and developmental work. Early intervention aimed at improving sensory integration can significantly enhance speech development, motor coordination, and cognitive functions in children with motor alalia. Modern correctional pedagogy increasingly emphasizes the importance of multisensory approaches that combine motor, tactile, visual, and auditory stimulation in speech therapy practice [6].

Despite the growing interest in sensory integration therapy, there is still insufficient methodological development regarding its systematic application in speech therapy programs for preschool children with motor alalia. Many existing approaches focus primarily on articulation training without considering the underlying sensory-motor mechanisms involved in speech formation [7].

Therefore, the development of effective pedagogical technologies aimed at forming sensory integration in preschool children with motor alalia remains an actual scientific and practical task. Such technologies can contribute to improving speech therapy outcomes and enhancing the overall adaptive abilities of children with speech disorders.



The purpose of this study is to develop and evaluate a technology for the formation of sensory integration in preschool children with motor alalia as part of комплекс corrective speech therapy intervention.

## Methods

The research was conducted using a комплекс pedagogical and speech therapy approach aimed at studying and developing sensory integration in preschool children diagnosed with motor alalia. The study involved preschool-aged children between the ages of 4 and 6 years who had previously been diagnosed with motor alalia by speech therapists and neurologists. The diagnosis was confirmed based on clinical observations, speech assessments, and neurological examinations. A total of 40 children participated in the study, and they were divided into two groups: an experimental group and a control group, each consisting of 20 children. The experimental group participated in a specially designed sensory integration development program integrated into speech therapy sessions, while the control group received traditional speech therapy correction methods without a specific sensory integration component.

The research was carried out in several stages. At the initial stage, a diagnostic assessment was conducted to determine the baseline level of sensory integration and speech development in the participating children. The assessment included observation methods, standardized speech therapy tests, and sensory processing evaluations. Speech development was evaluated based on several indicators, including vocabulary development, articulation skills, phonetic accuracy, and the ability to construct simple sentences. In addition, sensory integration abilities were evaluated through tasks that assessed tactile perception, proprioceptive responses, vestibular stability, motor coordination, and visual-motor integration. These assessments allowed researchers to determine the degree of sensory processing difficulties in children with motor alalia and identify specific areas requiring corrective intervention [1].

Following the diagnostic stage, a sensory integration formation technology was implemented in the experimental group as part of corrective speech therapy work. The technology was based on principles of multisensory stimulation and integrated pedagogical methods aimed at activating different sensory systems simultaneously. The program included a series of structured exercises designed to stimulate tactile, vestibular, proprioceptive, auditory, and visual sensory systems. Activities such as balance exercises, rhythmic motor games, tactile exploration tasks, articulation gymnastics combined with body movement, and coordinated hand-speech activities were systematically integrated into therapy sessions. These exercises were designed to improve body awareness, motor planning, coordination, and sensory processing, which are essential for the development of speech motor skills [2].

The sensory integration training program was conducted over a period of three months with sessions held three times per week. Each session lasted approximately 30–40 minutes and followed a structured format consisting of three phases: preparatory sensory activation, core corrective exercises, and final integrative tasks. During the preparatory phase, children participated in activities aimed at stimulating the vestibular and proprioceptive systems, such as swinging, jumping, and balancing exercises. These activities helped regulate the nervous system and prepare children for more complex speech and motor tasks. The core phase included targeted speech therapy exercises combined with sensory stimulation, including articulation practice supported by tactile cues, phonemic awareness activities accompanied by rhythmic movements,



and object manipulation tasks that required verbal labeling and description. The final phase focused on integrative games that combined sensory processing, motor coordination, and speech production within a playful context [3].

To ensure consistency and reliability of the intervention, all sessions were conducted by trained speech therapists who had prior experience in working with children with speech disorders. The therapists followed a standardized intervention protocol developed specifically for this study. In addition, the environment in which the sessions were conducted was carefully organized to provide appropriate sensory stimuli while avoiding excessive distractions that could interfere with the children's concentration and participation [4].

At the end of the intervention period, a post-intervention assessment was conducted using the same diagnostic tools and evaluation criteria applied during the initial assessment. The collected data were analyzed to compare the progress of children in the experimental and control groups. Quantitative and qualitative methods of analysis were used to evaluate improvements in speech development indicators and sensory integration abilities. Statistical comparison allowed researchers to determine the effectiveness of the sensory integration formation technology in improving speech motor development and overall communication abilities in preschool children with motor alalia [5].

Ethical considerations were also taken into account during the research process. Participation in the study was voluntary, and informed consent was obtained from the parents or legal guardians of all participating children. The intervention methods used in the study were non-invasive and consistent with established pedagogical and therapeutic practices aimed at supporting the development of children with speech disorders [6].

## Results

The results of the study demonstrated positive changes in the level of sensory integration and speech development among preschool children with motor alalia who participated in the experimental program. After the implementation of the sensory integration formation technology, significant improvements were observed in several indicators, including articulation coordination, vocabulary development, motor coordination, and the ability to combine speech with motor actions. In contrast, children in the control group who received traditional speech therapy methods showed progress primarily in articulation practice but demonstrated less improvement in sensory processing and motor coordination indicators.

At the initial stage of the study, both the experimental and control groups demonstrated similar levels of speech underdevelopment and sensory integration difficulties. Many children had problems with motor planning, articulation precision, tactile perception, and coordination of movements. Difficulties in combining speech production with motor activity were also frequently observed. These results correspond with previous studies indicating that motor alalia is often accompanied by disturbances in sensory-motor integration processes [1].

Following the three-month intervention program, the experimental group demonstrated noticeable progress in both sensory and speech parameters. Children became more confident in performing articulation exercises, showed improved coordination of speech and body movements, and demonstrated increased participation in communication activities.



Improvements were also noted in their ability to maintain attention during speech therapy tasks and respond to sensory stimuli in a more organized manner. The integration of vestibular, tactile, and proprioceptive stimulation into speech therapy sessions appeared to contribute to the activation of neural mechanisms responsible for speech-motor coordination [2].

In comparison, the control group also showed some positive changes due to traditional speech therapy exercises; however, the degree of improvement was significantly lower in areas related to sensory processing and motor coordination. Many children in this group continued to experience difficulties in performing complex articulation movements and integrating speech with motor actions. This indicates that speech correction methods that focus exclusively on articulation without addressing sensory integration may have limited effectiveness for children with motor alalia [3].

The comparative analysis of the results obtained before and after the intervention confirmed the effectiveness of the sensory integration formation technology used in the experimental group. The results indicate that systematic stimulation of sensory systems can positively influence speech development and motor coordination in preschool children with motor alalia.

**Table 1**

**Comparative indicators of sensory integration and speech development in children with motor alalia before and after the intervention**

<b>Indicators</b>	<b>Experimental Group Before (%)</b>	<b>Experimental Group After (%)</b>	<b>Control Group Before (%)</b>	<b>Control Group After (%)</b>
Articulation coordination	38	72	40	55
Vocabulary development	42	75	43	58
Motor coordination	36	70	37	50
Sensory responsiveness	34	73	35	48
Ability to combine speech and movement	30	68	32	46

As shown in Table 1, the experimental group demonstrated substantial improvements across all measured indicators. The most significant progress was observed in sensory responsiveness and vocabulary development, which increased by approximately 39% and 33% respectively. Improvements in articulation coordination and motor coordination were also considerable, reflecting the positive influence of multisensory exercises integrated into speech therapy sessions.



These results confirm that sensory integration-based pedagogical technologies can significantly enhance the effectiveness of corrective work with preschool children who have motor alalia. The integration of sensory stimulation with speech therapy exercises contributes to improved neural coordination between sensory perception and speech production mechanisms, thereby supporting the development of communication skills and adaptive behavior in early childhood [4].

## Discussion

The results obtained in this study confirm that the development of sensory integration plays a significant role in improving speech development in preschool children with motor alalia. The findings demonstrate that children who participated in the sensory integration-based intervention showed greater progress in articulation coordination, vocabulary development, motor coordination, and sensory responsiveness compared to those who received traditional speech therapy alone. These results support the assumption that speech development is closely connected with the functioning of sensory-motor systems and that disturbances in these systems may contribute to the persistence of speech disorders such as motor alalia.

Motor alalia is traditionally associated with impaired functioning of cortical speech-motor areas responsible for planning and executing articulatory movements. However, recent scientific research indicates that speech production depends not only on motor control but also on the integration of sensory feedback mechanisms, including tactile, proprioceptive, and vestibular inputs. Sensory information helps the brain regulate and adjust articulatory movements during speech production. Therefore, insufficient development of sensory integration can negatively affect the formation of stable speech patterns in children with motor alalia [1].

The results of this study correspond with the theoretical framework of sensory integration proposed by A. Jean Ayres, who emphasized that the effective organization of sensory information in the central nervous system is essential for coordinated motor actions and adaptive behavior. According to this theory, children with sensory integration dysfunction may experience difficulties in motor planning, coordination, and learning processes. Since speech production requires precise coordination of multiple muscle groups, disruptions in sensory processing may directly influence the development of articulatory skills and verbal communication [2].

The significant improvement observed in the experimental group suggests that multisensory stimulation can enhance neural plasticity during the preschool period. Early childhood is characterized by increased neuroplasticity, which allows the nervous system to adapt and reorganize in response to targeted developmental interventions. The integration of vestibular exercises, tactile stimulation, rhythmic movement, and speech therapy tasks appears to activate multiple neural pathways involved in speech-motor coordination. This multisensory activation may strengthen connections between sensory perception and motor planning systems, thereby facilitating more effective speech production [3].

Another important finding of this study is the improvement in the ability of children to combine speech with motor actions. In many children with motor alalia, speech production is often accompanied by difficulties in coordinating body movements and maintaining attention during communication tasks. The use of movement-based activities, rhythmic exercises, and sensory games within speech therapy sessions helped children regulate their motor activity and



maintain focus during verbal tasks. These results confirm the importance of incorporating active motor participation into speech therapy programs for children with developmental speech disorders [4].

The comparative analysis between the experimental and control groups also highlights the limitations of traditional speech therapy approaches that focus primarily on articulation training without addressing the underlying sensory-motor mechanisms involved in speech formation. Although articulation exercises remain an essential component of speech therapy, their effectiveness may be enhanced when combined with sensory integration activities that stimulate the neural systems responsible for motor coordination and sensory processing [5].

Furthermore, the improvement in sensory responsiveness observed in the experimental group indicates that sensory integration training may also positively influence broader aspects of child development, including attention regulation, emotional stability, and adaptive behavior. These improvements can create more favorable conditions for learning and social interaction, which are essential for the overall development of preschool children with speech disorders [6].

Despite the positive outcomes of the study, several limitations should be acknowledged. The sample size of the research was relatively limited, which may affect the generalizability of the results. In addition, the duration of the intervention was restricted to three months, and longer-term studies may be necessary to evaluate the stability of the observed improvements over time. Future research should also explore the effectiveness of sensory integration technologies in combination with other innovative speech therapy approaches and investigate their application in different age groups of children with speech and language disorders [7].

Overall, the findings of this study emphasize the importance of a multidisciplinary approach to the correction of motor alalia that integrates speech therapy, sensory integration training, and motor development activities. Such an approach may significantly improve the effectiveness of corrective interventions and support the development of communication abilities in preschool children with speech disorders.

## Conclusion

The present study investigated the effectiveness of a sensory integration-based pedagogical technology for improving speech development in preschool children with motor alalia. The results demonstrated that systematic sensory integration exercises integrated into speech therapy sessions significantly improved several key developmental indicators, including articulation coordination, vocabulary expansion, motor coordination, and the ability to combine speech with movement. Compared with traditional speech therapy methods, the proposed technology showed higher effectiveness in addressing not only speech deficits but also the underlying sensory-motor mechanisms associated with motor alalia.

The findings highlight that speech development is closely connected with sensory processing and motor planning processes in the central nervous system. Therefore, corrective interventions aimed solely at articulation training may not fully address the complex neurological mechanisms involved in speech production. The integration of tactile, vestibular, and proprioceptive stimulation into speech therapy programs can enhance neural connections



between sensory perception and motor control, which contributes to more stable and coordinated speech production in children with motor alalia.

In addition, the study confirms the importance of early intervention during the preschool period, when the nervous system demonstrates a high level of neuroplasticity. Implementing sensory integration technologies at this stage of development creates favorable conditions for improving speech functions, motor coordination, and overall adaptive behavior. Multisensory activities, movement-based exercises, and interactive games provide an effective environment for stimulating children's speech activity and communication skills.

Despite the positive results obtained, further research is recommended to expand the sample size, extend the duration of the intervention, and explore the application of sensory integration technologies in different types of speech and language disorders. Future studies may also examine the long-term effects of such interventions and develop more comprehensive methodological frameworks for integrating sensory integration therapy into speech therapy practice.

Overall, the implementation of sensory integration-based technologies represents a promising direction in the correction of motor alalia in preschool children and can significantly enhance the effectiveness of modern speech therapy and special education programs.

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