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The Effects of Physiotherapy Program with Ayres Sensory Integration Therapy for a 3-Years-Old Child with Low Muscle Tone and Speech Disorder: A Single Case Study

Düşük Kas Tonusu ve Konuşma Bozukluğu Olan Üç Yaşındaki Bir Çocukta Ayres Duyu Bütünleme Terapisi İçeren Fizyoterapi Programının Etkileri: Tek Vaka Çalışması

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Abstract

An optimal level of muscle tone is needed to continue activities of daily living. A delay in language development is a warning sign that there is a problem with the brain. Ayres Sensory Integration Therapy, which includes various body movements, stimulates multimodal sensory-motor systems and is frequently used in pediatric rehabilitation. This case report describes how a physiotherapy program with Ayres Sensory Integration therapy effected variables in the Developmental Screening Test, speech, muscle tone, and Antigravity Test in a three-year-old boy with low muscle tone and speech impairment. In order to evaluate the effect of the physiotherapy program including Ayres Sensory Integration Therapy on muscle tone and speech functions, the patient was taken into a 24-week physiotherapy program including Ayres Sensory Integration Therapy. Before and after treatment, Developmental Screening Test, speech, muscle tone and Antigravity Test were evaluated and recorded. At the end of the treatment, improvement was observed in all of the muscle tone, speech, Developmental Screening Test, and Antigravity test results. Children with low muscle tone and speech difficulties may benefit from physiotherapy programs that include Ayres Sensory Integration Therapy. In addition to speech therapy, children with speech problems should receive sensory integration therapy.

Keywords: Muscle tone, physiotherapy, sensation, speech disorder

Özet

Günlük yaşam aktivitelerini devam ettirebilmek için optimal düzeyde kas tonusuna ihtiyaç vardır. Dil gelişiminde gecikme beyinde bir sorun olduğuna dair bir uyarı işaretidir. Çeşitli vücut hareketlerini içeren Ayres Duyu Bütünleme terapisi, multimodal duyu-motor sistemlerini uyarır ve pediatrik rehabilitasyonda sıklıkla kullanılır. Bu vaka raporu, düşük kas tonusu ve konuşma bozukluğu olan üç yaşındaki bir çocukta Ayres Duyu Bütünleme terapisi içeren fizyoterapi programının Gelişim Tarama Testi, konuşma, kas tonusu ve Yerçekimi Testindeki değişkenlere nasıl etki ettiğini açıklamaktadır. Ayres Duyu Bütünleme terapisi içeren Fizyoterapi programının kas tonusu ve konuşma fonksiyonları üzerine etkisini değerlendimek amacıyla hasta Ayres Duyu Bütünleme terapisi içeren 24 haftalık bir fizyoterapi programına dahil edildi. Tedavi öncesi ve sonrası Gelişim Tarama Testi, konuşma, kas tonusu ve Antigravite Testi değerlendirilerek kayıt altına alındı. Tedavi sonunda kas tonusu, konuşma, Gelişim Tarama Testi ve Antigravite test sonuçlarının tümünde gelişme görüldü. Düşük kas tonusu ve konuşma güçlüğü olan çocuklar, Ayres Duyu Bütünleme terapisi içeren fizyoterapi programlarından fayda sağlayabilirler. Konuşma terapisine ek olarak, konuşma sorunları olan çocuklar duyu bütünleme terapisi almalıdır.

Anahtar Kelimeler: Duyu, fizyoterapi, kas tonusu, konuşma bozukluğu

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1. Introduction

Motor development is the voluntary movement of the organism in parallel with physical growth and development of the central nervous system (Konar & Şanal, 2019). One of the methods used to evaluate motor development in children is motor milestones (such as turning, crawling, and sitting). Both the developmental history and the neurodevelopmental assessment observations should be used to determine motor milestones. Motor milestones do not determine the quality of a child's motion. A complete neurologic examination (assessments of muscle tone, deep tendon reflexes, strength, and so on) is critical at this point (Edwards & Sarwark, 2005).

Muscle tone can be defined clinically as the tension felt during passive movement in the resting muscle and is achieved by a segmental mechanism. As with reflexes, upper neural structures in the brainstem, cerebellum, and cerebral hemispheres have a role in tone regulation. Muscle tone is maintained in a normal, aware, and relaxing person to maintain body balance. The brainstem contains the muscle-tone faciliatory and inhibitory systems. As a result, we can assume that the central nervous system (CNS) must engage synergistic muscles at structurally related joints in order to regulate balance. For posture control, the CNS organizes sensory input from the visual, somatosensory, and vestibular systems (Samuel et al., 2015).

Controlling the position of the body to orient body segments to a certain environment is known as postural control. Integration of perceptual information and movement adaptation influences postural control, which allows a person to maintain a steady position while engaging with the environment and is the foundation for most motor actions. An unusual perception action cycle can cause or contribute to a loss of postural control, which can lead to developmental delays (Dusing et al., 2014).

Neuromotor delays in infancy may set off a developmental cascade that contributes to the onset of social and communication problems later in life. Children with low muscle tone may encounter delays in important milestones like sitting, restricting opportunities for face-to-face interactions, peer interaction, and language learning over the first year (Serdarevic et al., 2017).

Ying described a pyramid containing the steps of learning (Williams & Shellenberger, 1996).According to Ying the foundational talents at the bottom of the pyramid are likely the most fundamental of the skills on the tiers above. Sensory motor, behavior, everyday living tasks, and academic learning can all be more efficiently developed once the pyramid's sensory system is appropriate. The Pyramid of Learning was demonstrated in Figure 1 below.

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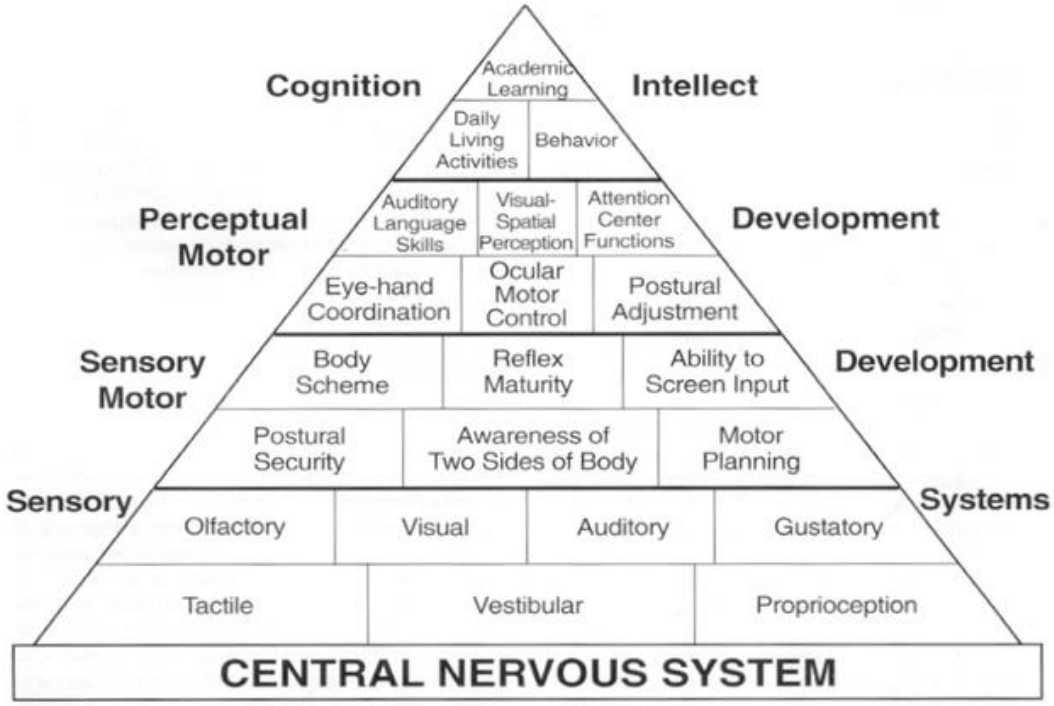

Figure1. The Pyramid of Learning (Williams & Shellenberger, 1996)

Children with a variety of disorders, varying from learning deficits with minor motor problems to cerebral palsy with more motor impairments problems, have been reported to have postural control failure. Physiotherapists and occupational therapists have historically prioritized the treatment of individuals with postural control difficulties since it appears to be a fundamental aspect of all motor functions. As a result, better postural control should lead to better mobility in general (Westcott et al., 1997).

A delay in language development is a common issue and a warning sign that something is wrong with the brain. Even if they do not have a hearing condition, some children do not listen well; it's as though the words enter their ears but get lost on their passage through the brain. Other children know what they want to say, but they can't get their mouths to start spewing it. Children with speech and language impairments who are also with vestibular dysfunction have a lot of trouble moving around (Jean., 1979).

The aim of our case study was to describe the effects of the physiotherapy program with Ayres Sensory Integration therapy for a child (toddler) with low muscle tone and speech disorders.

2. Method

2.1. Participant

Our study was conducted on a child with speech retardation named "M." by therapists. M. was a 3-year-old boy participating in a half-day prekindergarten program at the time of the intervention. He was carried to term and weighed 3.3 kg (7 lb 6 oz) when he was born, and demonstrated normal motor milestones as a newborn, according to his caregivers. When M. was 2 years old, his family noticed that he had a speech delay, and they took him to speech therapy twice a week. After 1 year of speech

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therapy, the family applied to a pediatric neurologist and the pediatric neurologist referred the family to sensory integration therapy. Thus, M.'s family applied to a physiotherapist with a sensory integration certificate working in a Rehabilitation Center in Istanbul. Written informed consent form was given to his legal guardians before the treatment, and they were informed about the process. The ethical requirements of the institutional and/or national research committees, as well as the 1964 Helsinki statement and its subsequent amendments or comparable ethical standards, were followed throughout the study.

2.2. Assessment

2.2.1.Speech assessment: The lingual part of the Denver Developmental Test and therapist's observational evaluation was used for speaking skills assessment. Denver II Developmental Screening Test results were applied before and after therapy by a specialist. Speech was also assessed by the therapist's observations during treatment.

2.2.2. Muscle tone assessment: The clinical hypotonia evaluation algorithm created by Govender and Joubert was used for muscle tone evaluation. (Govender&Joubert, 2018). According to this algorithm range of motion and posture were evaluated and a test of antigravity was performed. For joint range of motion and posture evaluation, the researchers evaluated joint hypermobility, flexibility, W sitting, lumbar lordosis and thoracic kyphosis. The 'Airplane Position' defined by Ayres was applied as the antigravity test.

2.3. Physiotherapy Program

M. continued both speech therapy (45 minutes per session) and Ayres Sensory Integration therapy (45 minutes per session) sessions twice a week during the 24-week treatment period. M.'s parents attended each therapeutic session and were taught how to apply the same strategies at home and in everyday situations. It was recommended that all that was learned during the day be used in activities of daily living.

To prepare M. for therapy and develop body awareness, physiotherapy sessions using Ayres Sensory Integration began with tasks containing tactile and proprioception stimuli (for example, putting toys with different fabrics and different hardness in the box, playing the game 'Being a Hamburger' with soft cushions, or rolling large therapy balls against resistance, etc.)

Following that, he was subjected to games that incorporated muscle-tone-increasing activities (jumping from a gripping bar to a soft mat, scaling a slide, or playing with a rope drawer were just a few examples).

Finally, the session was completed with the applications against anti-gravity (some of these included lying on the scooter in a prone position -The Airplane position- and swinging oneself with the aid of a rope to the targets established in the room, lying in the fabric swing in a prone position and swinging oneself with the help of a rope, and so on.)

While performing all these Ayres Sensory Integration based activities, M. was supported for vocalization, especially by singing songs with simple rhythms in swing activities that provide vestibular

sense. All of these activities, which M. found to be highly enjoyable, were combined into a method (challenge) that needed M. to reveal meaningful and appropriate sentences with proper grammar.

3. Results

3.1. Changes in Speech

3.1.1. The Denver II Developmental Screening Test results

Results of The Denver II Developmental Screening Test are given in Table 1. As a result of The Denver II Developmental Screening Test in January 2018, his social age was decided to be 15 months, lingual age was determined to be 15 months, fine motor development age was determined to be 13-14 months, and gross motor development age was determined to be 13-14 months, although M. was 36 months old.

Table 1. The results of The Denver II Developmental Screening Test

The Denver II Developmental Screening Test	Before Treatment (When M. is 36 months old.)	After Treatment (When M. is 42 months old.)
Social age	15 months	36 months
Fine motor development age	13-14 months	39 months
Lingual age	15 months	36 months

After the therapy program, test result of The Denver II Developmental Screening Test in June 2018 (6 months after the first test) was as follows: His social age was decided to be 36 months, lingual age was determined to be 36 months, fine motor development age was determined to be 39 months, and gross motor development age was determined to be 39 months, although M. was 42 months old at that time.

3.1.2. Qualitative assessment of speech by physiotherapists

Before Treatment: On the first observation, he stared when the name M. was mentioned several times. His eye contact was brief. He could not give proper answers to the questions asked. For example, when asked 'How are you?' he would reply 'It's very cold.' Grammatical errors were common in his sentences, and he referred to himself as an 'M'. For example, instead of saying 'I came.' he would say 'M came.' He often had 'echolalia'.

After Treatment: M. turned to look at the person when he was called by his name. His eye contact time increased. He answered simple everyday questions with complete grammar. He began to refer to himself as I. 'Echolalia' has completely disappeared.

3.2. Changes in Muscle Tone

3.2.1. Range of motion and posture

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Before Treatment: In the pre-treatment evaluation, hyperextension of the knees, increased lumbar lordosis and thoracic kyphosis were noted. It has been observed that M. preferred the 'W sitting' position while playing on the floor.

After Treatment: Improvement was observed in increased lumbar lordosis and thoracic kyphosis. Knees were in neutral extension. It was observed that M. uses the 'W sitting' position less frequently.

3.2.2. Antigravity test assessment

Before Treatment: M. was positioned prone on a scooter with extremities open (airplane position). M. was asked to keep his lower and upper extremities in extension. As shown in Figure 2, M. was able to hold the test position versus gravity for only a few seconds. Photographs of M. in the first and fourth seconds of airplane position evaluation are given in Figure 2 respectively.

Figure 2. Photographs of M. in the first and fourth seconds of airplane position evaluation, respectively After Treatment: In the final evaluation, M. was capable of holding the test position for longer periods of time and maneuver the scooter across longer distances with his upper extremities.

4. Discussion

In this case study, the results of the Ayres Sensory Integration physiotherapy program applied to a three-year-old boy with low muscle tone and speech disorder are included. In addition, the relationship between muscle tone and speech disorder was investigated. As reported in the literature, physiotherapy program with the Ayres Sensory Integration Therapy, which includes various body movements that stimulate multimodal sensory-motor systems, resulted in an increase in M.'s muscle tone and improvements in his speech skills.

The sensory-motor system of the brain is "multimodal," not "modular." As a result, language is multimodal by its nature in this regard, employing a multitude of interconnected modalities such as sight, touch, hearing, motor activities, and so on (Gallese & Lakoff, 2005). Sensory integration therapy aims to normalize sensory processing and, as a result, promote the development of higher, reliant brain functions like vocal and written language. Sensory integration was never supposed to be employed as a therapeutic tool outside of special education programs (e.g., speech and language services) (Mauer, 1999). It is a fact that Ayres Sensory Integration, which was included in the physiotherapy program in our study, caused improvement in speech.

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Sensory integration treatment can provide a wide range of feeling and movement alternatives with equipment that can be used for swaying, spinning, rolling, crawling, climbing, riding, jumping, and other full-body activities. These movements also could stimulate the muscles of the neck and upper trunk, as well as the semicircular canals (vestibular stimulation), in addition to producing an antigravity reflex action to stretch the upper trunk. A scooter-board can also provide similar vestibular stimulation while requiring the child's active participation (Kelly, 1987). The vestibular sensors detect gravity, movement, and the position of the body in response to the ground. Vestibular input indicates whether your body moves or not, as well as whether it is in upright or upside-down position. The proper integration of this sense is required for movement and balance, muscle tone, symmetrical coordination, visuospatial and auditory language processing. Vestibular dysfunction arises when a child's sensitivity to movement is either too high or too low. Oversensitive youngsters, often known as "gravitationally insecure," dislike fast movements, rough (like sand or grass) or unsteady (like escalators or boats) surfaces, and frequently become car sick (Withrow, 2007). Sensory integration therapy can help people with vestibular dysfunction (Ayres, 1978). The developments in our case can be seen as a result of the use of vestibular stimuli. Sensory integration therapy, according to Ayres, can help both language understanding and expression, depending on the severity of sensory integration dysfunction (Ayres & Mailloux, 1981).

Although the methods accepted in the literature were used for muscle tone assessment in our study, the lack of an objective method is the missing aspect of the study. The use of objective evaluations in future studies will yield more reliable results.

5. Conclusion

Physiotherapy programs that include Ayres Sensory Integration can be helpful to reduce symptoms in children with low muscle tone and speech disorders. Children with speech problems should receive sensory integration therapy in addition to speech therapy sessions. Children with low tone should be evaluated in terms of sensory profile even if they do not have any symptoms.

Authors Contributions

Topic selection: MK; Design: MK; Planning: MK; Data collection: MK, NG; Data analysis: MK, NG; Article writing: MK, NG; Critical review: NG**.**

Conflict of Interest

There is no conflict of interest, according to the authors.

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