



## CASUISTIC PAPER

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# Effects of sensory integration therapy in a 7-year old child with epilepsy following craniocerebral trauma – a case study

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### ABSTRACT

**Introduction.** Post-traumatic epilepsy develops as a complication of a serious craniocerebral trauma, frequently an open head injury, resulting in neurological impairments.

**Aim.** The study was designed to discuss problems associated with sensory integration dysfunction observed in a seven-year old girl with epilepsy which occurred as a result of craniocerebral injury.

**Description of the case.** The case study is based on information gained from the girl's medical records, an interview with her guardians and a sensory function questionnaire. Additional examinations assessed the girl's balance control, and her functional performance according to Barthel scale. The girl received a three-week sensory integration therapy which included exercise involving tactile, vestibular and proprioceptive stimulation, as well as balance exercises and self-care training.

**Conclusions.** In this particular case, application of sensory integration therapy produced beneficial results. The findings show improvement in balance, coordination as well as self-care.

**Keywords.** epilepsy, rehabilitation, sensory integration

### Introduction

The timing of the first epileptic seizures following craniocerebral trauma is varied. The incidence of post-traumatic seizures in children is difficult to determine due to the scarcity of the related population studies. Generally, the prevalence of seizures in children, irrespective of the type (early or late seizures), the children's age, as well as severity of the trauma, is estimated to range from 5.5 to 21%.<sup>1</sup> Patients with post-traumatic

epilepsy (PTE) account for about 5% of all the individuals referred for treatment to epilepsy centres. PTE is frequently drug resistant. In addition to their capacity to induce seizures, head injuries may also adversely affect the progress of the condition in patients with epilepsy.<sup>2</sup> Etiological factors of the condition occurring in children include maturation of the central nervous system (CNS), perinatal or intrauterine damage to the CNS and any genetically conditioned disorders of pubertal devel-

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opment.<sup>3</sup> PTE, which usually contributes to the affected person's severe disability, is the predominant long-term complication of craniocerebral injury. It typically develops during the first five years following the head injury.<sup>4</sup>

During the first years of life a child acquires the largest number of skills and the largest amount of information about the surrounding world. These experiences are collected via sensory perception. Deficits connected with the disease may hamper normal functioning and consequently disturb normal development.<sup>5</sup> Sensory integration involves processing of sensory information from our body and environment, for use in our daily life.<sup>6</sup> Sensory integration therapy focuses on the child's abilities in three areas: modulation of motor information processing, differentiation of the information, and its integration with action.<sup>7</sup>

Sensory integration method was developed in the 1960s, by Jean Ayres, an educational psychologist and occupational therapist. The author created the theory of sensory processing dysfunction. Ayres observed that sensory integration deficits affect postural response, muscle tone, movement planning, speech development, behaviour, emotions and cognitive functions. Initially the therapy was used in children with learning difficulties, and today it is also applied in children with delayed psychomotor development.<sup>5</sup>

In its hypothetical model of development, the method distinguished development of sensory, proprioceptive and vestibular perception, balanced responses, integration of primitive reflexes, development of body image, ability of motor planning, as well as visual and auditory perception. These at a later stage are followed by development of precise hand movements (lateralisation, ability to differentiate between the sides of the body), visuomotor coordination as well as spatial perception.<sup>6</sup> The therapy is mainly designed to normalise perception of stimuli by applying varied frequencies, to normalise muscle tone by means of relaxation, balance training, and spatial positioning of the body; it also aims at reconstruction of body image.<sup>6</sup> Impaired sensory processing is associated with inability to use information obtained via senses to enable smooth functioning in the daily life. Sensory modulation is described as regulation of sensory input by the brain. This is linked to a child's response to stimuli. Owing to sensory stimulation, a child can determine which sensory input they must pay attention to and which can be ignored. Impairments in sensory modulation are mainly associated with abnormal enhancement or inhibition of stimuli in the vestibular system, proprioception, as well as senses of touch, vision, hearing and smell.<sup>7,8</sup>

Sensory integration therapy may be administered to children with epilepsy. However, it is necessary to take into account the possible overloading of the nervous system with excess sensory stimuli, e.g. resulting from

accumulation of the child's sensory experiences during the day. Movement is an indispensable factor organising brain activity, and for a child it is linked with pleasure; furthermore, research shows that good physical condition favourably affects the course of epilepsy. However, during sensory integration training it is necessary to keep in mind certain limitations and avoid intense simultaneous vestibular and visual stimulation, intense vibration stimulation particularly applied to auricular region, the skull bones, and neck muscles, intense stimulation of superficial sensibility (gentle, skin-stroking massage) which particularly affects the nervous system. During a therapeutic session, in the case of these children, rest intervals should be used between exercises much more often; these could be a good opportunity to introduce proprioceptive stimuli.<sup>9,10</sup>

### **Aim**

The purpose of the study was to present sensory integration dysfunction observed in a seven-year old girl with epilepsy resulting from a craniocerebral trauma, and to assess effects of the impairment in the girl's functioning.

### **Description of the case**

The present case study is related to a 7-year-old girl who at five months of age, under unclear circumstances, experienced craniocerebral injury, as a result of which she received a surgery due to epidural and subdural hematoma. Long-term consequences of these events included spastic quadriparesis, epilepsy and delayed speech development. The girl was delivered naturally, at 42 weeks of pregnancy; 10 points in Apgar scale at birth.

Neurological examination identified horizontal nystagmus, speech deficits (the girl could say isolated words), discrete left-side hemiparesis, gait abnormality, no meningeal signs. Laboratory tests, including examinations towards toxoplasmosis, Lyme disease and thyroid hormones showed normal results. Head MRI showed malacic lesions bilaterally in parieto-occipital region, accompanied with peripheral gliosis and dilatation of the occipital horn and trigone of the right lateral ventricle; lesions resembling glial scars in both cerebellar hemispheres; thin corpus callosum; dilatation of supratentorial system and Evans ratio.

Physical examination showed such abnormalities as wide-based gait, need for protection while walking up the stairs, impaired balance and motor coordination, fear of unknown surfaces, lack of targeted graphomotor skills and multi-point grip, difficulties in self-care (the girl does not like combing, washing and touching; she cannot get dressed without help, she rarely communicates her physiological needs; no sphincter control). She depends on other people. The child received antiepileptic treatment (Depakine Chronosphere), and currently experiences no seizures. Visible absence seizures were

confirmed by EEG examination (weak sleep spindles; In the occiput on the right side continuous disconnections of non-typical IFs, and low IFs of 1.5 c./s.).

The girl has difficulty adopting to new environments, she is anxious and fearful and does not like to be left by herself. She does not initiate contact with others, and does not understand complex instructions. Her speech development is delayed, she can imitate sounds and selectively follow simple instructions. Psychological examination did not identify autistic behaviours.

The child currently has very limited contact with her parents and remains in the custody of her grandparents. They live in a detached house with a large backyard. The girl attends an outpatient neurorehabilitation unit five days a week. As reported by her guardians, the main problems are connected with emotional adaptation (attacks of squealing, screaming, crying), difficulty falling asleep, physiological needs, and fear of medical personnel. In the past there were problems during meals, because she was unable to eat by herself. The situation has improved, and now the girl can use a spoon and fork. The interdisciplinary team taking care of the girl includes therapists and specialists in ophthalmology, neurology, rehabilitation, neurological speech therapy and psychology. Her disability has been certified by specialists.

The program of sensory integration therapy included exercise stimulating tactile system, deep sensation, visual perception, and fine motor skills, and exercise in movement planning. Exercise affecting vestibular system focused on balance control, visuo-motor coordination, muscle tone, and spatial orientation. Exercise stimulating proprioception focused on sense of the body, spatial orientation, and muscle tone. Self-care training included exercise focusing on fine motor skills and learning body image.

The therapy was conducted every day for three weeks. The exercises were carried out in a playful form.

The examination was performed before the start of the therapy and after 15 days of the training, in the same conditions and using the same measurement tools. Effects of the therapy were assessed with the following tools:

1. Questionnaire, designed for assessing school-age children with symptoms of sensory integration deficits, proposed by Grzywniak, and containing statements related to specific symptoms of impaired sensory integration and their intensity

(does not like to travel by a fast driving car, especially while it is taking a turn, suffers from motion sickness, supports his/her head with hands while sitting in class, reads slowly with disturbed rhythm pattern, is hyperactive, faces difficulties trying to focus, faces difficulties while getting dressed, is shy and withdrawn, gets angry frequently, hates some scents, does not tolerate some

flavours or textures of food, likes to swing or turn on a merry-go-round, and never has enough, falls asleep faster if he/she can hear specific sounds).<sup>10</sup>

Assessment is based on the following scores:

0 — no symptoms, 1 — symptom occurs rarely, 2 — symptom occurs occasionally, 3 — symptom occurs frequently with some intensity, 4 — symptom occurs always or almost always.<sup>10</sup>

2. Functional assessment according to Barthel scale – measurement of performance in 10 basic activities of daily living (feeding, transfers, grooming, toilet use, washing, bathing, walking, climbing stairs, dressing/undressing, faecal continence, urinary continence); it does not assess psychological and social functioning. The scale rating: I. 86-100 points – “mild” condition, II. 21-85 points – “moderate” condition, III. 0 - 20 points – “severe” condition.<sup>11</sup>

3. The Step Test – enables assessment of the ability to maintain balance in dynamic conditions, typical during walking in the presence of obstacles. The trial measures the number of steps performed with one foot onto and off a 7.5 centimetre high block, within 15 seconds. The subject is asked to perform the activity as quickly as possible, without any help, and the other foot must remain in full contact with the floor. Both healthy legs are tested.<sup>12</sup>

4. Get Up and Go Test – the subject is asked to perform a few simple activities, i.e. to stand up from chair (seat height of 46 cm) from a sitting position, walk along a flat surface at a distance of 3 metres, cross the line marking the distance, turn 180°, return to the chair and resume the sitting position. Time is measured from the moment the person, seated on a chair, is given the command to “start”, to the moment he/she resumes a sitting position. The subject is asked to perform the task as quickly as possible, at a pace which is safe for him/her.<sup>12</sup>

5. One Leg Standing Test – it is an easy-to-conduct test which does not require any equipment except for a stopper. It assesses the subject’s ability to maintain static balance, while standing on one foot without any support. The time is measured from the moment the subject’s foot has been lifter to the moment it makes contact with the floor again.<sup>12</sup>

## Discussion

After the questionnaire was completed, significant deficits in sensory integration were identified. The score amounted to 95 points, and the most frequently selected responses, 3 and 4, may reflect severe dysfunctions in the girl.

Assessment of the girl’s performance based on Barthel scale showed moderate disability, in accordance

with the score of 50 points (category II: 21-85). In the present case study, following the therapy administered, the child presented a slight improvement in coordination and balance. In the Step Test, after 15 days of the therapy, the girl achieved improvement of two steps and one step in the right and the left leg, respectively, compared to the baseline. The result in Up and Go Test was also improved after the therapy, the girl was able to perform the task 3.5 seconds faster than at the start of the program. In One Leg Standing Test there was also improvement; after the therapy the girl was able to stand on the right leg for 2 seconds, while at baseline she failed to complete the task of standing on both the right and left leg (Table 1).

**Table 1.** Comparison of results in the tests, before and after the exercise with elements of sensory integration training, as well as effects of rehabilitation

Tests	Before	After	Effects of rehabilitation
The Step Test in 15 seconds	6x(repetitions)- right foot 4x- left foot	8x(repetitions)- rights foot 5x- left foot	+ 2x +1x
Up and Go Test in seconds	15 seconds	11.5 seconds	- 3.5 seconds
One Leg Standing Test in seconds	Failure to perform the task – both legs	2 seconds – right leg Failure to perform the task – left leg	Improvement in the right leg

x- number of repetitions

The present study showed that a rehabilitation program combined with elements of sensory integration therapy, even with short duration of such treatment, produced beneficial effects in the girl's ability to focus on the motor task performed. It also led to relaxation of the body and decrease in muscle tone. Supporting a child's development with the use of sensory integration therapy is very important. After a specified duration of the exercise it is possible to observe effects relative to therapeutic assumptions and goals, such as improvement in the child's psychomotor condition.<sup>7</sup>

Rehabilitation is a process which should be initiated at the same time as a medical treatment, e.g. in this case pharmacological therapy, at each stage of its advancement. This is because such disorder as epilepsy may significantly affect the results of treatment, the outcome of therapy will not depend exclusively on the sensory deficits of the child. The condition may lead to general weakness, and lack of willingness to perform motor exercise. Due to this, children tend to like sensory therapy, as it is carried in a playful form, and it does not require precision of movement. The small patients eagerly perform

such activities because therapy is tailored to the functional condition of each child. Rehabilitation with elements of sensory integration enables adequate stimulation of the vestibular system in patients with balance deficits.<sup>8</sup>

According to Emmons et al., rehabilitation based on sensory integration techniques enables adequate stimulation of the vestibular system in patients with balance disorder. This method is particularly effective when applied to small children. Since they affect the vestibular system and proprioception, sensory integration techniques may be an alternative or, in the case of older children, a supplement to standard vestibular habituation training used in treatment of balance disorders.<sup>12</sup>

Before the specific therapeutic program is designed for children with deficits it is necessary to perform in-depth diagnosis of the system of balance and sensory integration. It is more difficult to perform diagnosis in children than in adults due to problems connected with assessing specific ailments. Therefore, support from parents in identifying any disorders is of critical importance for every aspect of rehabilitation and examinations. In order to assess integration abnormalities, and determine whether they are caused, e.g. by incomplete myelination occurring by the age of 4-5 years, it is helpful to perform examinations and comprehensive observations, because it is only after this stage that children can be examined with the use of tests for adults.<sup>13-17</sup> According to the scarce data reported in the literature children with vestibular disorders may benefit from rehabilitation focusing on reduction of sensory deficits. Children usually respond to this type of exercise more rapidly than adults, because of the greater plasticity of the central nervous system and its capacity to compensate for and to adapt to a vestibular dysfunction.<sup>18</sup>

The present case study shows that therapy plays a significant role in the process of learning new activities and in improving the child's quality of life. After the therapy program was introduced it was possible to observe decreasing reticence in the girl, she started making visual contact, was able to say more words, create short sentences, and express her willingness or unwillingness to perform some exercise. In order to assess effectiveness of sensory integration therapy applied in the present study, the findings could be compared to research by other authors focusing on a similar problem and applying this type of therapy. Any discrepancies may be linked with the different disease occurring in the child because there are no articles discussing this particular condition. Krzywińska- Wiewiórska et al. report that rehabilitation should be introduced in the case of children with chronic diseases.<sup>19</sup>

The findings reported by Fazlioglu et al., who conducted a study in a group of 30 children with autism, ranging in age from 7 to 11 years, confirm effectiveness of sensory integration therapy.<sup>20</sup> Effectiveness of sensory

integration therapy in children with Autism Spectrum Disorder was also shown in review studies.<sup>21,22</sup>

In summary, the above findings suggest that sensory integration training may beneficially affect functional capacities, balance control and coordination in a child with post-traumatic epilepsy due to head injury.

## Conclusions

Sensory integration therapy produced beneficial results in a 7-year-old child with PTE due to craniocerebral injury. In this specific case improvement was observed in self-care skills, balance control and in motor coordination. It is necessary, however, to perform further research involving a larger sample, and employing a greater number of measures, in order to draw far-reaching conclusions.

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