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The Impact of Hippotherapy Integrated with Kinesiology Taping on the Quality of Trunk Stabilisation in Children with Spastic Form of Infantile Cerebral Palsy

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Abstract

Aim: Hippotherapy is a method of motor rehabilitation which has its roots in neurophysiology. Conducted with the participation of a horse, which, moving in the walk, transmits its vibrations to the body of the rider. Kinesiology Taping is a method consisting in using adhesive tapes with extensibility close to the stretching properties of human skin, providing sensory and proprioreceptive effect. The aim of the research was to assess the impact of hippotherapy and Kinesiology Taping on the quality of trunk stabilisation in children with spastic form of infantile cerebral palsy. **Material:** The research covered 26 children at the age of 2 - 18 years (average age: 10,625+/-4,95) with diagnosed spastic form of infantile cerebral palsy. The presented population was randomly divided into two groups, 13 people each. Group H - children attending hippotherapy, Group KT - children attending hippotherapy supported with Kinesiology Taping. **Results:** An increase in the maximum tension of the straight muscle of abdomen was observed in 10 out of 11 persons in group with Kinesiology Tapes applied, and in 7 out of 13 in the group of persons without tapes applied. Analysing the differences in the quality of trunk stabilisation in children with individual types of ICP in Groups KT and H, we can notice that in the group undergoing hippotherapy supported with Kinesiology Taping, lack of improvement was observed in only 1 patient with spastic diparesis, whereas in the group subjected to only hippotherapy, no improvement was observed in two patients with spastic diparesis and in four with tetraparesis. **Conclusions:** This study proves that Hippotherapy has a significant impact on improving the trunk stabilisation in children with ICP. Particularly, it could be observed in the group additionally subjected to the application of Kinesiology Tape.

Keywords: Hippotherapy; Kinesiology taping; Biofeedback, Cerebral palsy; Poliomyelitis; Children

Introduction

The term *infantile cerebral palsy* (ICP) dates back to the 19th century, but only during the last 20 years it has been decided about the purposefulness of using the collective definition referring to this disorder [1]. There are several definitions of this syndrome, and all of them describe ICP as a heterogeneous group of movement and posture disorders resulting from a non-progressive insult to the immature brain. According to the definition by the Surveillance of Cerebral Palsy in Europe (SCPE), we are talking about "continuously changing over time impairments of movement or posture, or movement and posture, with function disorders, resulting from permanent non-progressive damage to brain, which is in a stage of uncompleted development" [2,3]. According to various statistics, the frequency of ICP occurrence varies between 1,5 - 3/1000 of live births, and has remained at the same level for years, in spite of the improvement in neonatological care [4-7]. The etiology of this syndrome is quite complex. The greatest significance has the ischemic-anoxic syndrome, intracranial intraventricular and periventricular haemorrhages (particularly in premature infants), and also the condition of hyperbillirubinaemia, as well as the mother's diseases and condiments used. According to the definition, the basic symptoms are disorders of movement and posture – for their description, most frequently the division proposed by Ingram is used, who marks out the following forms: bilateral hemiplegia, bilateral spastic paralysis, hemiplegia, a cerebellar form and extrapyramidal form. It is most often accompanied by epilepsy, sight or hearing damage, speech disorders, as well as mental impairment and disturbances of behaviour and emotions [2,8-10].

A damage to the Central Nervous System (CNS) causes that the muscle tension distribution in spontaneous movements is incorrect. The ability to adjust the tension appropriately to the performed movement is a very important element in diagnostic assessment. Taking in consideration the antigravity skills of a child with CP, all of the patients may be classified as *flaccid in the trunk* (so called *central postural hypotonia*) [1,7].

Hippotherapy is a method of motor rehabilitation which has its roots in neurophysiology. Conducted with the participation of a horse, which, moving in the walk, transmits its vibrations to the body of the rider. The Polish Hippotherapeutic Association (PTHip), provides the following definition of hippotherapy: „Hippotherapy is a guided therapeutic action, aimed at improving human functioning in physical, emotional, cognitive and/or social spheres, during which a specifically prepared horse makes an integral part of the therapeutic process" [10,11] .

We distinguish 3 basic horse gaits, but the gait used in hippotherapy, actually exclusively, is the walk. The other gaits are not used in a patient therapy. The motor impulses transmitted from the horse's limbs to its back are further transferred to the patient, thanks to the contact surface created between the rider's buttocks and the horse's back. The first therapeutic aim is to achieve mobility of the pelvis in the sagittal plane, and then transmission of the stimuli along the spine takes place, which

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has an impact on keeping the right posture of the rider, normalizing the tension of postural muscles and, eventually, on regaining the physiological spine curvatures.

Kinesiology Taping is a method consisting in using adhesive tapes with extensibility close to the stretching properties of human skin, providing sensory and proprioreceptive effect. The author of Kinesiotaping method is a Japanese chiropractor – Dr Kenzo Kase. In the 70's of the 20th century, he introduced original elastic tapes, called „Kinesio Tex", to the practice of rehabilitation. Years of experience and clinical research caused that the Kinesiotaping method in 2007 was transformed into Kinesiology Taping method. It is based on the assumptions of Soft Tissue Therapy and uses the knowledge on muscle chains [12,13].

The adhesive tape stretches only in one direction, which enables precise correction of the skin and fascia system. The relief of the fascia system occurs thanks to the increased space between the skin layer and the fascia [12,13].

Trunk stability can be defined as the ability to maintain active control of spinal and pelvic posture during dynamic loading and movement conditions. Both neural control and muscle strength are important determinants of trunk stability. Certain muscles have been shown to be primary stabilizing muscles. In our studies improvement in trunk stability is connected with better control of contraction and relaxation of abdominal muscles-one of the most important of postural muscles.

There are publications about the importance of hippotherapy in patients with cerebral palsy which assess the impact of therapy on the overall mobility of children, using as a tool the scale GMFM (Gross Motor Function Measure) [14-16]. All authors recognize the positive impact of hippotherapy on large motor skills of children with cerebral palsy. Referring to the studies included in the article, improvement of the overall motor would not be possible without improving the quality of core stabilization [15].

The results are also confirmed in the research of T. Shurtleff [17]. By means of video recordings and measurement of anterior-posterior translation of the spine, stabilization of the trunk after hippotherapy in children with spastic cerebral palsy was assessed. The reduction of mobility in the upper part of the spine, despite the vibrations transmitted by the movement of the horse to the pelvis, was considered as a mechanism of improving the core stabilization. The results confirm that after the regularly conducted hippotherapy followed the progress in building the activity of postural muscles.

The aim of the research was to assess the impact of hippotherapy and Kinesiology Taping on the quality of trunk stabilisation in children with spastic form of infantile cerebral palsy. The study combined the two methods because the aim is to check whether both methods used at the same time will be more effective than applied separately (Figures 1-7).

Resources and Methods

The research covered 26 children at the age of 2 – 18 years (average age: 10,625+/-4,95)with diagnosed spastic form of infantile cerebral palsy.

The presented population was randomly divided into two groups, 13 people each. Group H – children attending hippotherapy, Group KT – children attending hippotherapy supported with Kinesiology Taping. Because of reasons out of our control, 2 persons resigned from the

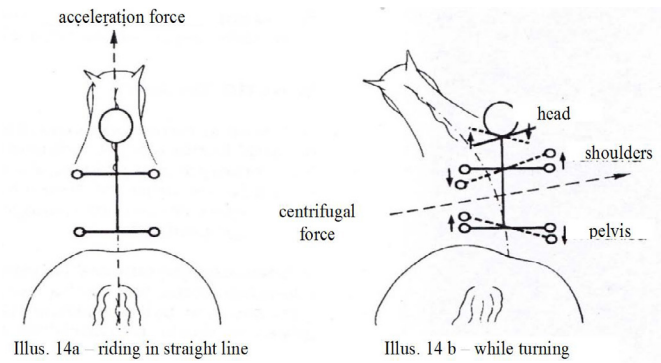

Figure 1: Impact of the acceleration and centrifugal forces on the balancing reaction while riding straight and while turning. [10].

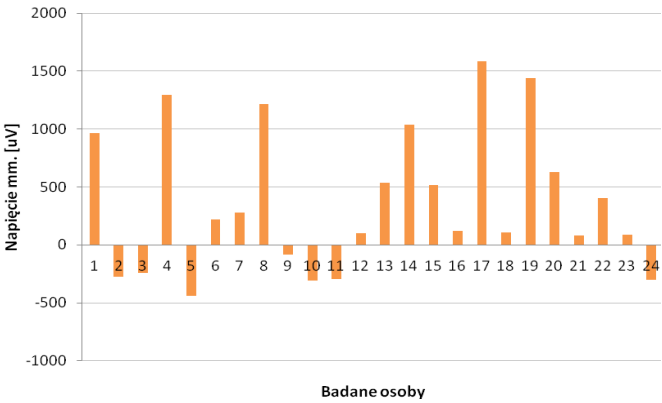

Figure 2: The difference of tension divergence in the straight muscle of abdomen after performed examinations.

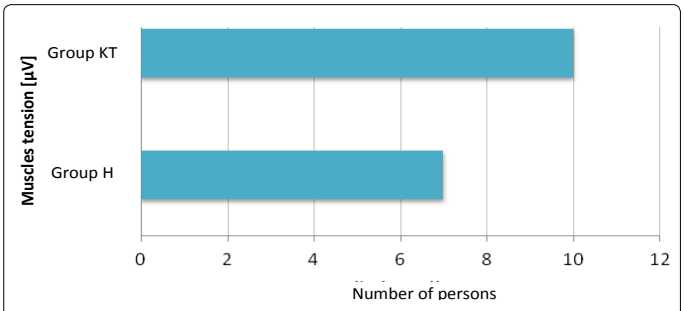

Figure 3: Comparison of the researched groups in terms of the trunk stabilisation improvement.

therapy, so finally 24 persons were subject to the research: 11 persons in Group KT and 13 persons in Group H. 11 out of 24 children (46% of the researched group) were at the age of 7-12 years, 8 out of 24 (33% of the researched group) were patients at the age of 13-18 years, 5 out of 24 children (21% of the researched group) were within the age range 2-6 y.o., 15 out of 24 (62% of the researched children) were girls. In 17 children out of 24 (71% of the researched persons) no mental impairment was found, and 7 out of 17 (29%) had slight or moderate impairment.

In terms of the form of cerebral infantile palsy, the patients were divided into 3 groups:

With diparesis: 16/24 (67%)

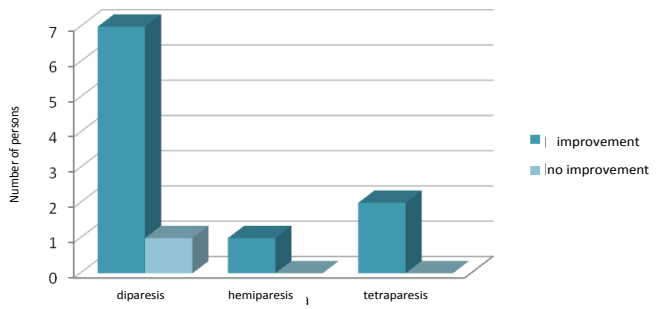

Figure 4: Comparison of trunk stabilisation in terms of the type of paresis in Group KT.

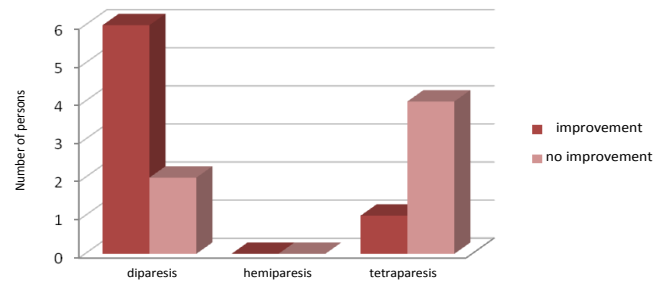

Figure 5: Comparison of trunk stabilisation in terms of the type of paresis in Group H.

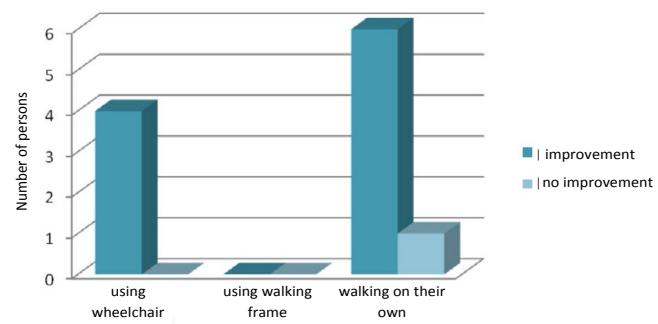

Figure 6: Comparison of trunk stabilisation in terms of way of moving in Group KT.

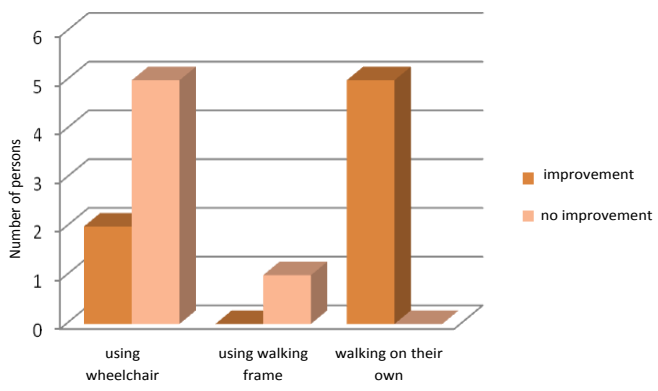

Figure 7: Comparing trunk stabilisation in terms of way of moving in Group H.

With tetraparesis: 7/24 (29%)

With hemiparesis: 1/24 (4%)

12/24(50%) children moved on their own, 11/24(46%) on a wheelchair, and 1/24 (4%) with a walking frame. 18/24 (75%) persons were secured "from below", 6/24 (25%) required safeguarding from "above"[1]. The criteria qualifying for the research included: diagnosed spastic form of infantile cerebral palsy and age up to 18 years.

The excluding criteria included allergy or other contraindications for Kinesiology Tape application, and any contraindications for hippotherapy.

Each child was twice subjected to physiotherapeutic assessment – the first time, before commencing the research; and the second, at its conclusion, i.e. after 3 months of the therapy.

The assessment comprised: the general medical interview [Appendix No. 1] and the measurement of the tension of straight muscle of abdomen (rectus abdominis) with the use of the EMG biofeedback device [Appendix No. 2 and 3].

All the children, from both groups, participated in hippotherapy activities for 3 months, taking place 2 times a week, in the stable Rzeczna in Reda. During the research, each child was subject to 24 hippo-therapeutic sessions. Before commencing the cycle of classes, the hippo-therapist filled in a card of hippotherapy course for every child. [Appendix No. 4] .Treatment sessions runned from 30 to 60 minutes and were planned individually based on goals set by the therapist. There are multiple positions the therapist can incorporate with activities on the horse to challenge the patient to achieve goals as well as to improve the ability to follow directions.

During the project, the researched group had the Kinesiology Tapes applied every week. During the 144 meetings, on average 864 applications were made on the individual groups of muscles [Appendix No. 5].

All statistical calculations were made in Statistica10 - StatSoftPolska. For the statistical evaluation of quantitative parameters nonparametric McNemar's test was used – test for dependent variables. Values are considered significant when $p < 0.05$.

Results

An increase in the maximum tension of the straight muscle of abdomen was observed in 10 out of 11 persons in group with Kinesiology Tapes applied, and in 7 out of 13 in the group of persons without tapes applied.

For each of the patient, the differences of tension divergence[2] in the straight muscle of abdomen were calculated between the first and second examination.

Analysis of EMG m .rectusabdominis in population after hippotherapy and hippotherapy assisted by Kinesiotaping showed a significant increase in the difference between the tension and relaxation, which may suggest an increase in the capacity of the muscle and affect the quality of core stabilization.

Analysing the differences in the quality of trunk stabilisation in children with individual types of ICP in Groups KT and H, we can notice that in the group undergoing hippotherapy supported with Kinesiology Taping, lack of improvement was observed in only 1 patient with spastic

[1]Safeguarding „from below" - the hippo-therapist stands beside the horse, „from above"- the hippo-therapist sits on the horseback together with the patient

[2]Divergence – the difference between the contraction and relaxation

diparesis, whereas in the group subjected to only hippotherapy, no improvement was observed in two patients with spastic diparesis and in four with tetraparesis [Illustration].

Dividing the examined persons in terms of way of moving, the following persons were found: these using a wheel chair, using walking frame, and moving on their own. The graphs show the differences in the quality of trunk stabilisation in children in the presented groups:

Discussion

The so far issued publications devoted to the significance of hippotherapy in improving the condition of persons with infantile cerebral palsy, evaluate the impact of the therapy on the children's general motor activity, using the GMFM (Gross Motor Function Measure) scale as a tool [14-16]. All authors acknowledge the positive influence of hippotherapy on extensive motor activity of children with ICP. No improvement of the general motor activity would be possible without improving the quality of trunk stabilisation [15]. This is also proved by the research presented in this work.

The therapy results presented here are also confirmed by the research work by T Shurtleff [17] where, with the use of video recordings and measuring the anteroposteriortranslation of the spinal column, the stabilisation of the trunk was assessed after hippotherapy in children with spastic form of ICP. Decreasing the mobility in the upper part of the spinal column, despite the vibrations transmitted by the horse movement to the pelvis, was acknowledged as the mechanism of perfecting the trunk stabilisation. The results obtained from our research confirm that, after regularly performed hippotherapy, a progress occurs in building up the activity of postural muscles. However, a greater improvement was observed in children who, beside hippotherapy, were subjected to Kinesiology Taping applications (10 out of 24 researched children), which suggests a positive effect of applying the adhesive tape on the abdominal muscles with a technique aimed at trunk stabilisation.

In D. Bertoti's publication, it was emphasised that therapeutic horse riding has more significant influence on posture control in children with diparesis (6/8) than in these with tetraparesis (2/8) [18]. For the research, mentally retarded children were qualified at the age of 2 to 9 years. In the study covered in this work, 19% of the children had mental impairment, and beside the children with diparesis and tetraparesis, a boy with hemiparesis was also admitted. Despite a more diversified research group, a significantly greater improvement of the trunk stabilisation was observed in persons with diparesis (13/24) than with tetraparesis (3/24). Although, it must be admitted that both groups of patients are characterised with a lowered tension of trunk muscles, in case of tetraplegia, we cope with impaired control of holding the head and, certainly, this results in worse response of this population to the therapy [18,19]. This may be also confirmed by the result obtained after comparing the group in terms of the way of moving. All children with tetraparesis were moving on wheelchairs. An improvement of the trunk stabilisation was observed in 6 out of 24 persons using a wheelchair, and in 11 out of 24 persons walking on their own.

The analysis done with EMG of the straight muscle of abdomen, in the population after hippotherapy supported with Kinesiology Taping, showed a significant increase of the difference between the values of the tension and the relaxation, what may suggest an increase in this muscle's efficiency and have an impact on the quality of trunk stabilisation. After the hippotherapy classes, increased amplitude of tension in the straight muscle of abdomen was found, which is equivalent to increase in its strength. A confirmation of this conclusion can be found in the research conducted by Meta Nystrom Eek, one goal of which was to examine the muscle strength in children with ICP [20]. A hand myometer was used for this measurement, whose electrode was placed on a specified group of the active motor apparatus. The author proved that increasing the amplitude of a muscle tension confirms increasing this muscle's strength. Only W. Benda used EMG for evaluating the children with ICP after performed hippotherapy, but in this research the difference in muscles tension was not analysed, and only the symmetry of their work [21]. The electrodes were placed on the thoracic and lumbar parts of the spine and on the group of abductors and adductors of the thigh. The assessment covered the symmetry of muscle work, obtained by relaxing the overactive muscles and increasing the activity of the contralateral muscles. It was proved that a better symmetry of the muscles work was achieved in children using hippotherapy (64,6%) than in children examined on a static barrel (12,8%). An increase in the symmetry of muscles work suggests also an improvement of the posture control [21].

The effectiveness of shockwave therapy could have been examined in this sort of research. It improves the vascularisation [22] and enables improvement not only in peripheral arterial diseases but also could be used in the therapy of spastic muscles.

In regards to paediatric patients, researchers described that a single session of shock wave therapy focused on plantar flexors in children affected from cerebral palsy with spastic equinovarus foot produces a significant long-lasting (>12 weeks) reduction in muscle tone [23].

One of the causes of cerebral palsy is vascular insufficiency occurring before or during child birth. In order to observe vascular differences among patients suffering from cerebral palsy extracranial venous Doppler evaluation could have been performed. Ciccone [24] and Cicirello [25] have already made such investigation in the group of patients suffering from multiple sclerosis.

Conclusions

This study proves that Hippotherapy has a significant impact on improving the trunk stabilisation in children with ICP. Particularly, it could be observed in the group additionally subjected to the application of Kinesiology Tape.

Comparing the examined persons in terms of the way of moving, the greatest level of improvement in the trunk stabilisation was found in persons moving on their own.

The greatest difference in the level of trunk stabilisation between Groups KT and H was observed in persons moving on wheelchairs. In Group KT, the improvement of trunk stabilisation occurred in all persons, and in Group H, only in 2 out of 7 examined persons.

Summary

Infantile cerebral palsy (ICP) belongs to frequent disorders of the developmental age. The greatest importance in developing ICP has the ischemic-anoxic syndrome and intracranial haemorrhages, and not without significance are the infections undergone during the period of uncompleted development of the nervous system.

According to the definition, the basic symptoms are disorders of movement and posture. Taking in consideration the antigravity skills of a child with CP, all of the patients may be classified as *flaccid in the trunk* (so called *central postural hypotonia*).

The aim of this study was the assessment of impact of hippotherapy and Kinesiology Taping on the quality of trunk stabilisation in children with the spastic form of infantile cerebral palsy.

The material for this research comprised 26 children, at the age of 2 to 18 years, with the spastic form of ICP. The patients were divided into two groups: KT – attending hippotherapy classes and having Kinesiology Tapes applied, and H – attending the hippotherapy classes only. Due to reasons remaining out of control, 2 patients resigned, and finally there were 11 children in the Group KT, and 13 children in Group H.

Each child was two times subjected to physiotherapeutic assessment. The tension of straight muscle of abdomen (rectus abdominis) was examined with an EMG biofeedback device.

An improvement of the quality of trunk stabilisation and increase in the tension of the straight muscle of abdomen were observed in 10/11 (90%) persons in Group KT, and 7/13 (54%) in Group H. The greatest improvement of the trunk stabilisation was noticed in persons walking on their own. As the conclusion, we can say that Hippotherapy supported with Kinesiology Taping provides positive effects in rehabilitation of children with infantile cerebral palsy, the same impacting the quality of trunk stabilisation.

The research is a kind of pilot trial. It will be recommended to confirm the results of studies on a larger number of patients.

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