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LETTER TO THE EDITOR

The effects of robotic gait neurorehabilitation and focal vibration combined treatment in adult cerebral palsy

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Dear Editor,

Cerebral palsy (CP) is an unprogressive neurological condition resulting from an injury to the developing brain. Most of the published studies on rehabilitation methods focused on children with CP and only recently the outcomes in adults with CP are receiving increased attention.

We report a case of a 25-year-old woman with a spastic form of CP with gross motor function classification system (GMFCS) level IV who was treated with robotic gait rehabilitation concomitantly with focal vibration and conventional physical therapy.

She was born prematurely at 27 weeks gestational age (birth weight was 950 g, length 36 cm) and diagnosed with intracerebral hemorrhage. Habilitation program begun at the age of 3 months. It consisted of once a week 45 min of Bobath therapy sessions performed in a hospital specialized in children with neurodevelopmental disorders and 4 times a week home exercises for 1 hour with her mother following instructions of physical therapists. Once a year she went to a rehabilitation hospital where she received physio kinesiotherapy and hydrotherapy 2 h a day during time period of 3 weeks. The patient achieved independent verticalisation and started walking with the help of a walker at the age of 8. After the age of 8, she performed stretching exercises at home 5 times a week, 1 h a day. Once a year, she went to a rehabilitation hospital where she received physio-kinesiotherapy, hydrotherapy, electrotherapy 3 h a day during time period of 3 weeks. She stopped growing at the age of 14. From that time, her walk was unstable and with a walker. The degree of habilitation was sustained through stretching exercises at home and physiotherapy interventions in rehabilitation hospital for 3 weeks once a year with no further progress in walking distance, stability, dynamics, and speed. Last treatment in rehabilitation hospital was 6 months prior to admission to our clinic.

When the patient came to our attention, she could make longer distances only with a help of a wheelchair, and using a walker, her walking distance was 20 m. Her gait was spastic paraparetic, with an unstable pattern on a wide base of support and with impaired walking dynamic. When supine, she could flex her hips and knees to 90 degrees with feet in plantar flexion and only able to initiate dorsiflexion. When knees were flexed, she could flex her feet to neutral position. Bilateral manual muscle test (MMT) for hip flexion was 3/5, for knees extension 4/5, for knees flexion 3/5 and for foot dorsiflexion 2/5. Modified Ashworth scale (MAS) for hamstrings and gastrocnemius muscles was 3 bilaterally. Functional independence measure (FIM) was 77. Gait velocity during 10 m walk test (10MWT) with the use of walker before treatment was 0.21 m/s for average self-selected velocity and 0.53 m/s for average fast velocity.

She was treated for 12 weeks with Lokomat (Hocoma AG, Switzerland) gait therapy, physical therapy using Bobath method and focal vibration (Vibramoov, Techno Concept, France). Bobath therapy was performed before Vibramoov followed by Lokomat therapies 5 times a week, each Bobath session lasting for 1 hour. Focal vibration was applied to muscle belly of bilateral quadriceps and tibialis anterior muscles. Vibration frequency was 75 Hz, and the amplitude range between 2 and 3 mm. Each daily session consisted of 60 min treatment during which each vibration, stimulation lasted 60 s and was followed by 5 s of pause. Training frequency was 5 times a week, each session lasting for 1 hour. Lokomat sessions were performed 5 times a week, each session lasting for 1 hour. No drug regimen was implemented or modified.

After the treatment, she could walk up to 1 km with one crutch. Gait was still spastic paraparetic, with a more stable

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gait pattern at more narrow base of support and improved walking dynamics. When supine, she could flex her hips to 100 degrees and flex knees to 90 degrees. Her feet were in plantar flexion, when knees were flexed she could perform dorsiflexion to neutral position. Bilateral MMT for hip flexion was 4/5, for knees extension 5/5, for knees flexion 3/5 and for foot dorsiflexion 3/5. Lower extremity muscle tone was reduced, MAS was 1+ for bilateral hamstrings and gastrocnemius muscles. FIM increased to 100. Gait velocity during 10MWT was 0.42 m/s for average self-selected velocity and 0.86 m/s for average fast velocity.

Follow-up examination was made 3 months later. In comparison to the clinical status at discharge, a slight increase in muscle tone was observed, MAS for bilateral hamstrings and gastrocnemius muscles was 2. The results of 10MWT were 0.33 m/s for average self-selected velocity and 0.74 m/s for average fast velocity.

Different rehabilitation approaches have been used in children with cerebral palsy such as physical therapy and behavioral therapy, pharmacologic treatment with baclofen, diazepam, tizanidine, botulin toxin type A, neurosurgery, or orthopedic surgery [1]. It is believed that training regimes commonly achieve higher efficiency in children compared with adult patient groups due to higher plasticity potential in children immature brain and spinal cord [2].

Robotic gait rehabilitation systems are new rehabilitation tools used in neurorehabilitation of various neurological diseases. Lokomat is a lower extremity exoskeleton robotic rehabilitation system combined with dynamic body weight support system and a treadmill which ensures physiological gait pattern. Robotic training with Lokomat has shown positive effects in children and adolescents with CP [3]. Focal vibration is receiving increased attention as a neurorehabilitation tool for focal spasticity. Using mechanical oscillations, it influences neuromuscular modulation by altering spinal reflex activity. There is evidence of positive effects of vibration therapy on muscle tone and spasticity occurring concomitantly with improved movement ability in regard to gross motor function, strength, gait, and mobility [2].

Combination of upper limb robotic therapy and transcranial magnetic stimulation with good effects on upper limb function in an adult with CP has been described [4]. A combination of upper limb exoskeleton and focal vibration has been described in stroke patients with a positive effect on upper limb spasticity, motor function, mood, and anxiety. It is hypothesized that adding focal vibration augments neuroplasticity processes induced by intensive, task-oriented robotic training [5].

This is the first report to describe the combination of lower limb robotic therapy and focal vibration in CP. Our results show a positive effect on global functionality, gait, muscle tone, strength, and indicate that the combination of focal vibration and robotic gait training is a promising rehabilitation approach in adults with CP.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent Informed consent was obtained from the participant included in the study.

Statement of human rights The study has been approved by the Ethics committee of Polyclinic Glavic and has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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