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SPASTIC DIPLEGIC CEREBRAL PALSY: GMFM88 IN CHILDREN BEFORE AND TWO YEARS AFTER PHYSICAL REHABILITATION

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ABSTRACT

The study aimed to assess gross motor function in children with spastic diplegia – the second most common form of cerebral palsy (CP) – before and after two years of physical rehabilitation by means of conventional physiotherapy interventions. The study was conducted at the Ken Walker University Clinic of Medical Rehabilitation (Georgia, Tbilisi) among 31 children with spastic diplegia aged 5 to 12 years old (inclusive). The functioning of the clinic is supported within the framework of a project funded by the United States Agency for International Development (USAID), the goal of which is to develop physical rehabilitation in Georgia (Tbilisi). The specialists have undergone full professional education and training under the guidance of experts from the Emory University School of Medicine. The children with spastic diplegia were divided into four age groups: group aged 5 – 6 consisted of 8 patients; group aged 7 – 8 consisted of 8 patients; group aged 9 – 10 consisted of 8 patients; group aged 11 – 12 consisted of 7 patients. The level of the child's ability was assessed in accordance with the Gross Motor Function Classification System. The Gross Motor Function Measure (GMFM-88) was used in the evaluation of gross motor function in children with cerebral palsy, which took into account the 5 qualitative characteristics (lying and rolling; sitting; crawling and kneeling; standing; walking, running, and

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jumping) for the planning of the intervention and the assessment of rehabilitation effectiveness. Children underwent an interdisciplinary rehabilitation program before and two years after conventional physiotherapy. As a result gross motor function scores significantly increased in all age groups, especially in 5–6-year-old children. The efficiency of conventional physiotherapy interventions is confirmed by the increased range of motion in all joints of the lower limbs, reduced spasticity and improved balance function.

Cerebral palsy (CP) is a debilitating condition that places a significant burden on the health, educational, and social support systems, as well as on families and individuals affected by it. [27] It is a neurological disorder, which can occur before birth, during birth, within a month after birth, or during the early years of a child's life while the brain is still developing; affects a person's ability to control muscles caused by abnormal brain development or damage to the developing brain [15]. In most affected children progressive musculoskeletal pathology occurs.[3] CP is an umbrella term encompassing etiologically diverse symptoms, which change with age. It is not a single disease, but a name given to a wide variety of static neuromotor impairment syndromes occurring secondary to a lesion in the developing brain. The damage to the brain is permanent and cannot be cured but the consequences can be minimized. Over the years, the definition of cerebral palsy has been repeatedly changed. Nevertheless, it is still easier to explain what is not cerebral palsy, than to define it precisely. [25]

The Cerebral Palsy Alliance Research Foundation (CPARF), the foremost nonprofit organization in the world focusing on research and innovation for people with cerebral palsy, reports that globally, about 18 million people have some form of cerebral palsy. According to Disabled World (a highly recognized website serving the disability community, addressing a diverse array of challenges and experiences faced by the approximately 16% of the global population living with significant disabilities), symptoms of cerebral palsy include difficulty with fine motor tasks such as writing, poor balance and walking, and involuntary movements. The exact combination of symptoms differs from patient to patient and may vary over time. Some patients also have seizures and intellectual disability. Similar CP rates appear to be in both the developing and developed worlds. Cerebral palsy occurs in about 2.1 per 1000 live births. In those born at term, rates are lower at 1 per 1000 live births. The rate is higher in males than in females. In Europe, it is 1.3 times more common in males. [9] The incidence of CP increases with premature or very low-weight babies, regardless of the quality of care. However, multiple other

factors have been associated with an increased risk for CP, including maternal infections, and multiple gestation. In most cases of CP the initial injury to the brain occurs during early fetal brain development; intracerebral hemorrhage and periventricular leukomalacia are the main pathologic findings found in preterm infants who develop CP. [9] Today, it is accepted that only approximately 10% of cases of CP can be attributed to neonatal asphyxia. [3] High risk factors that contribute to the development of cerebral palsy are congenital brain malformation, genetic predisposition, hypoxic-ischemic encephalopathy, intra-abdominal stroke, in vitro fertilization, low birth weight, infection during pregnancy, multiparity, neonatal sepsis, postnatal meningitis, postnatal brain trauma. [23] According to the Cerebral Palsy Statistbcs 85% to 90% of CP cases are birth-related (abnormal brain development or damage occurred before or during birth) .[29] However, in many instances, the specific cause remains unknown.

Historical documents indicate that cases of cerebral palsy date back to ancient civilizations. A medical examination of the mummified body of the Egyptian Pharaoh Siptah (ruled from 1196 to 1190 BC) was the oldest evidence of the above-mentioned physical disorder. In particular, Siptah is thought to have cerebral palsy due to deformed foot and hands [12]. It should be noted that through the centuries, many people with cerebral palsy and other disabilities were seen as socially unacceptable. The first medical description of cerebral palsy was made by Hippocrates in his work “Corpus Hippocraticum”.

Although cases of this group of neuromuscular disorders were known from ancient times, the term *Cerebral Palsy* did not exist until the early 19th century. [21] Every attempt to define and treat a disease has its pioneers, and cerebral palsy is no exception. They are William John Little (1810-1894), William Osler (1849 – 1928), and Sigmund Freud (1865-1939). W.J. Little was the first to define what is now known as spastic cerebral palsy as a brain injury caused by oxygen deprivation at birth in a paper presented to the Obstetrical Society of London in 1861. His work was so innovative that spastic cerebral palsy was first known as ‘Little’s disease.’ William Little also discussed the value of treatment and early intervention. [14] Towards the end of the 19th century, William Osler and Sigmund Freud added to the knowledge of the above-mentioned condition. While W.J. Little depicted only one form of cerebral palsy, W. Osler explored many other forms of impairment and presented case studies and suggestions for the possible causes of the disorder, and termed it as *Cerebral Palsy*. [18] Later, Sigmund Freud, a psychiatrist and neurologist, was the first to state that cerebral palsy might be caused by abnormal development before birth. He was the first to write about cerebral palsy as a nosologic category, uniting the wide range of infantile motor impairments caused by abnormal brain development under one term: *infantile cerebral palsy.* The investigation of the brain and its pathways allowed Freud to conclude a connection between cerebral palsy and such disorders as intellectual disabilities, visual impairments, and

seizures, and to state that these conditions were likely caused by problems occurring very early in the development of the brain and central nervous system before birth. Despite this observation, researchers and doctors continued to follow Little's conclusions.[1, 10, 13, 25, 28, 30] The significant developments that have followed since then are all due to the contributions of these three personalities in the field of cerebral palsy, who laid the foundation for many more discoveries and innovations [6]. According to the current definition, developed by an international team of experts, cerebral palsy is a group of permanent, but not unchanging, disorders of movement and/or posture and of motor function, which are due to a non-progressive interference, lesion, or abnormality of the developing/immature brain. The diagnosis of cerebral palsy is mainly based on motor function and posture disorders that occur in early childhood and persist until the end of life; they are non-progressive but change with age. Motor function disorders, which are the core symptoms of cerebral palsy, are frequently accompanied by other dysfunctions, such as sensation, perceptual, cognitive, communication and behavioral disorders, epilepsy, and secondary musculoskeletal disorders. [4].

There are four main types of movement disorders associated with cerebral palsy. They are categorized as spasticity, dyskinesia, ataxia, or mixed/other [28]. *Athetoid Cerebral Palsy or Dyskinetic Cerebral Palsy* is the second most common type, marked by abnormal movements and muscle control in the arms, legs, and hands, making this type of CP challenging I terms of controlling body coordination and mobility. Ataxic Cerebral Palsy – least common type of cerebral palsy impacting around 6% of children; it is marked by the loss of control of full body movements. A child may appear unsteady and shaky in their arms and legs because their balance and depth perception are affected. Mixed Cerebral Palsy (a combination of different cerebral palsy types) is the result of multiple brain injuries that are located in numerous spots of the brain and result in affecting about 10% of children. These classifications also reflect the areas of the brain that are damaged. The subject of our research – *spastic diplegia (SD)*, also known as diplegic cerebral palsy – where spasticity (muscle tightness) of the legs is the exclusive or almost exclusive impairment present; it is a condition in which the legs are more severely affected than the arms. In spastic diplegia, the patient's cognitive function is preserved and the patient is able to live independently. Spasticity is the most common movement disorder in children with cerebral palsy. Movement disorders of cerebral palsy can result in secondary problems, including hip pain or dislocation, balance problems, hand dysfunction, and equinus deformity[23]. Once cerebral palsy has been diagnosed, the Gross Motor Function Classification System can be used to evaluate severity and treatment response. Treatments for the movement disorders associated with cerebral palsy include intramuscular onabotulinumtoxin A, systemic and intrathecal muscle relaxants, selective dorsal rhizotomy, and physical and occupational therapies. [5; 28; 23].

Treatment for spastic diplegia primarily focuses on promoting the brain's ability to make adaptive changes and rewire its neuroplasticity. This mechanism is what allows for functions affected by brain damage to be rewired to healthy, unaffected areas of the brain. The most effective way to promote neuroplasticity is to focus on task-specific repetition.

The brain functions on demand, so the more you practice any skill, the stronger the neural pathways for it will become. At young ages, the brain has a higher level of neuroplasticity, making early intervention ideal. However, the brain never loses its ability to adapt, so there is potential for improvement at any age. Individuals can learn to significantly improve their quality of life with the right treatment. One of the most important forms of treatment for CP is physical therapy. It uses exercises, therapeutic massage, adaptive equipment, heat treatments, and more to improve mobility, balance, flexibility, and muscle strength. Many physical therapists will incorporate games and activities, such as obstacle courses and balancing challenges, into their treatments with pediatric patients. This is a great way to motivate children with spastic diplegia to be fully engaged in therapy and can allow parents to more easily encourage practicing the skills learned in physical therapy at home.

Before the 19th century there were no specialized treatments available for physical disabilities. However, some early practices, such as massage and movement exercises, were employed to improve mobility and alleviate muscle stiffness, though they were not specifically tailored for CP. Although cerebral palsy was defined during the 1800s, it wasn't until the 20th century that treatments started to be researched. András Pető, a Hungarian physical rehabilitation practitioner, worked on physical therapy of children with CP to help them to walk and move easier. His methods, although a little evolved now, are still widely used today. Santhakumar Raja summarized the history and importance of physical therapy for cerebral palsy from its emergence to present and concluded that physical therapy began to formalize as a profession in the 20th century, and by the mid of the century it has formed into specialized field. In the 1940s and 1950s, Karel and Berta Bobath developed the Bobath Concept, a neurodevelopmental treatment approach specifically for children with CP. The Bobath approach focused on improving movement patterns and inhibiting abnormal reflexes, emphasizing individualized therapy based on each child's needs. This approach became and still remains to be a cornerstone of physical therapy for CP today. It is worth noting that, despite the progress made in understanding the nature of cerebral palsy, questions of specific tactics remain open. Due to the multilevel organization of human locomotor neural networks that ensure vertical balance, questions about methods of influencing them remain unresolved. Maintaining a normal vertical position is one of the important conditions for human life, which allows him to actively interact with the external environment. The development of orthotic devices helped manage spasticity and improve mobility.

The use of assistive technology, such as walkers and wheelchairs further enhanced the quality of life for individuals with CP.

A better understanding of the condition in the 1960s and 1970s stimulated a close work of pediatricians, physical therapists, neurologist, occupational therapists, psychologist, and speech-language pathologists. Due to joint efforts progress was achieved and children with CP got the best care possible. Pediatricians assess a child's physical and neurological development to ensure they are meeting age-appropriate milestones. Cerebral palsy doctors who specialize in neurology play an important role in managing the motor challenges caused by the condition. They focus on how the brain affects movement, muscle tone, and coordination, creating treatment plans tailored to each child's needs. A neurologist for cerebral palsy collaborates with a care team to coordinate the best support, identifies motor challenges like spasticity or muscle stiffness, manages muscle tone through treatment. A speech therapist works closely with the child's parents on improving and developing the following skills: chewing, eating, swallowing, pronouncing sounds, syllables, and words; expressing one's own thoughts, understanding the speech of others. The aim of the psychologist is to assess and correct the patient's psychological and emotional sphere, the degree of mental development or mental retardation; to positively influence the emotional state of the child and his family and help them cope with the stress caused by the diagnosis. A pediatric physical therapist performs an initial evaluation of a child: assessment of development, mobility, strength, and balance. Physical therapy is essential for minimizing the impact of spasticity in the legs. As was mentioned above, spastic diplegia can be mild to severe and affect different muscles in the legs, so a personalized approach is needed. By emphasizing individualized care, this therapy empowers children to flourish physically and reach their full potential to capable future. Physical therapy is an effective form of treatment for spastic diplegia because it focuses on repetitions, which consistently stimulates the brain. The more you practice, the more you're activating neuroplasticity and strengthening those brain-to-muscle connections. At physical therapy, individuals with spastic diplegia may work on stretching spastic muscles, strengthening sleepy or underused muscles, and walking with improved form. Physical therapy regimens of assisted stretching, strengthening, functional tasks, and/or targeted physical activity and exercise are usually the chief ways to keep spastic CP well-managed, although if the spasticity is too much for the person to handle, other remedies may be considered, such as various antispasmodic medications [32].

Physical therapy is an integral part of multidisciplinary approach for pediatric rehabilitation to promote both psychological and functional independence of cerebral palsy children. Each child with cerebral palsy is unique and the professionals looking after the child must provide an evaluation of his or her specific situation. [2, 11, 16]

Physiotherapy plays a key role in the management of CP and comprises various therapeutic interventions in enhancing physiological and functional outcomes. Though physiotherapy is widely used and recommended by all members of the health-care team, the effectiveness of physiotherapy is inconsistent. Pediatric physical therapy supports children in building strength, coordination, and balance through guided exercises. Occupational therapy is an integral part of the rehabilitation team and a valuable component in the interdisciplinary treatment of individuals with CP. It aims to enhance the functionality of individuals through the practice of daily living activities, which helps individuals develop the abilities needed for greater self-reliance. Unlike physical therapy, which focuses on improving flexibility, mobility, and strength through exercise, occupational therapy primarily utilizes practical tasks and activities to prepare individuals with cerebral palsy for everyday situations, helps to make them more independent [8].

Pediatric occupational therapy seeks to improve children's engagement and participation in life roles [17]. While some traditional exercises may be incorporated into occupational therapy sessions, they serve as a means to an end: increased participation in valued activities. Occupational therapists teach individuals to perform self-care tasks such as eating, sleeping, bathing, grooming, toileting, and transferring; use adaptive tools and mobility aids to perform activities they may not be able to do on their own; communicate effectively and behave in a socially appropriate manner.

From the late 20th century onward, the emphasis in physical therapy for CP shifted towards evidence-based practice. Research into the effectiveness of various interventions led to more targeted and scientifically grounded treatments. Techniques like constraint-induced movement therapy, treadmill training with body weight support, and aquatic therapy have shown promise in improving motor function in children with CP. The integration of technology into physical therapy has also revolutionized treatment for CP. Robotic-assisted therapy, virtual reality, and computer-assisted interventions offer new ways to engage children in therapy and track progress. Despite these advancements, challenges remain in the field of occupational and physical therapy for CP. While many therapies can improve function, there is still no cure for CP, and the effectiveness of treatments can vary widely among individuals. Future directions in occupational and physical therapy for CP include a focus on personalized medicine, where treatments are tailored to the genetic and neurological profiles of each child. Cerebral palsy specialists include neurologists, developmental behaviorists, genetic specialists, and pediatricians. Advances in neuroplasticity research, which explores how the brain can reorganize itself in response to therapy, hold promise for developing new interventions. There is also a growing emphasis on early intervention, with the hope that starting therapy as soon as possible after diagnosis can lead to better long-term outcomes. While there have been significant achievements in improving mobility and quality of life for individuals

with CP, ongoing research and innovation continue to push the boundaries of what is possible in this field [25].

The aim of the research was to evaluate gross motor function in children with spastic diplegia before and two years after receiving physical rehabilitation at the Ken Walker University Clinic of Medical Rehabilitation (Georgia, Tbilisi). The functioning of the clinic is supported within the framework of a project funded by the United States Agency for International Development (USAID), the goal of which is to develop physical rehabilitation in Georgia (Tbilisi). The specialists have undergone full professional education and training under the guidance of experts from the Emory University School of Medicine.

The study was conducted among 31 patients with spastic diplegia aged 5 to 12 years old (inclusive), before and after two years of complex rehabilitation treatment, based on an interdisciplinary approach **(40 courses – 384 procedures)**. Individual rehabilitation doctor, neurologist, physical therapist, occupational therapist, speech therapist, orthopedist and orthotist were involved in the treatment process. The recruited patients were divided based on age into four groups: group I consisted of 8 patients (age range 5 to 6); group 2 contained 8 patients (aged 7 to 8); group 3 consisted of 8 patients (age range 9 to 10); group 4 contained 7 patients (age range 11 to 12). The level of the child's ability was assessed in accordance with the Gross Motor Function Classification System. The Gross Motor Function Measure (GMFM-88) was used in the evaluation of gross motor function in children with cerebral palsy, which took into account the 5 qualitative characteristics: lying and rolling; sitting; crawling and kneeling; standing; walking, running, and jumping for the planning of the intervention and the assessment of rehabilitation effectiveness.[24] The performance of each item was rated from 0 to 3 points. The assessment of the severity of spastic diplegia was determined by the ability to move independently. Five levels of disease severity were determined based on these functions. The obtained material was statistically processed using the SPSS program. To test the null hypothesis (H), the Mann-Whitney U-criterion was used (since the distribution function is unknown), the U-criterion was defined with a = 0.05 significance level (95% probability) and degrees of freedom v = 14. The critical value of the U-criterion is equal to 13. For each age group, the U-criterion value was found to be $U<U_{cr.}$, which means that the difference between the two variables before treatment and 2 years after treatment is significant ($P<0.05$). It is noteworthy that in all age groups, the average rate after 2 years of treatment significantly exceeds the results of the first assessment. The data of different age groups before and two years after treatment was compared. The aim was to find out the difference between the corresponding quantitative indicators presented in percentages of qualitative characteristic data (lying and rolling; sitting; crawling and kneeling; standing; walking, running, and jumping. Gross motor score according to age groups before treatment (I single-choice) and the corresponding quantitative indicators presented in

percentages of qualitative characteristic data (lying and rolling; sitting; crawling and kneeling; standing; walking, running, and jumping. Gross motor score) according to age groups after 2 years of treatment (II single-choice).

Exercise is defined as a planned, structured and repetitive activity that aims to improve fitness, and it is a commonly used intervention for people with CP. Physical therapists develop a recovery plan designed for each patient's specific needs. Kids with spastic diplegia did special exercises to improve their fine motor skills, body balance, and correct body perception. A type of physical therapy that specifically concentrates on improving one's ability to walk is gait training. Gait training is a form of physical therapy that is designed to enhance an individual's walking capabilities. It can involve practicing exercises in the pool or walking on a weight-bearing treadmill. These activities relieve pressure on the joints, allowing individuals to focus on improving their form. They also minimize the risk of falls and injuries, which often makes individuals feel more comfortable with practicing more challenging skills. We used different types of exercises with the children. For example, separating Hercules flakes, sitting in a hammock, throwing colored balls into a tube. Exercises were mainly aimed at the child's abnormal movements and blocks, which were broken down with the help of dissociation into the following pairs: Head - shoulders; Suprascapular muscles (near the collarbone) - upper limbs; Pelvic girdle - shoulder girdle; Upper limbs - lower limbs; Right leg - left leg. With the preliminary inclusion of passive exercises, the following were treated: Upper limbs: fingers, radius-wrist, elbow, shoulder; Lower limbs: fingers, ankle-shin, knee, hip-thigh, neck muscles. (Movement: flexion-extension). During treatment, attention was paid to: The unity of the organism (flexion, extension, primitive); Disease-specific tone (in the pelvis, shoulders, torso, upper limbs, lower limbs); The pattern of movement (raising the head, turning, sitting, squatting, standing, walking). Factors hindering movement (what prevents the performance of normal movement and why). Pathological patterns (flexion, extension). Exercise interventions for CP for patients under observation. Cerebral Palsy. Pelvic-femoral block (I variant.): 1. Dissociation of the pelvis and shoulders 2. Rotation, 3. Extension of the lumbar muscles, 4. Dissociation of the upper limbs and lower limbs. Pelvic-femoral block (II variant.): 1Dissociation of the pelvis and shoulders 2. Rotation, 3. Dissociation of the upper limbs and lower limbs. 4. Dissociation between the legs. Physical training took place in the gym individually under the supervision of a physical therapist. At the beginning of the training, the child stood on a treadmill and began to walk. Then the child was placed against a Swedish wall and his sitting balance was worked on. The child was placed on an adapted path and given crutches. The child had to move forward, backward, and sideways. The child was placed on a trampoline with hoops and had to perform jumps. The patient also had to wear hoops. The child was taught to climb and descend stairs, to jump on a

trampoline. Physical exercise took place in front of a mirror to help the child become aware of his body. Physical therapists use bicycles to improve patient legs movement. As a result of these exercises, the child's fine motor skills, coordination, balance, and the patient's emotional and sensory state improved. The results of the study were the corresponding quantitative indicators presented in percentages for the assessment of 5 qualitative characteristics (Lying and rolling. 2. Sitting. 3. Crawling and kneeling. 4. Standing. 5. Walking, running, and jumping) and Goal total score. In tables 1 – 4 are presented the data of different age groups before and after rehabilitation.

Table 1. *GROSS Motor Function Measurements (GMFM88) of 5- 6- years old children with spastic diplegia) before and after rehabilitation.*

Field (5-6 years old)	*Before rehabilitation*	*After rehabilitation*
Lying on the back and rolling	70,08±1,73	96,4±3
Sitting	41,4±3,18	84,3±3,12
Crawling and kneeling	13,7±2,83	63,6±8,96
Standing	2,6±0,26	53,4±8,55
Walking, running, and jumping	1,64±0,24	45,38±7,3
Goal total score	25,97±1,32	76,41±5,38

Table 2. *GROSS Motor Function Measurements (GMFM88) of 7-8- years old children with spastic diplegia) before and after rehabilitation*

Field (7-8 years old)	*Before rehabilitation*	*After rehabilitation*
Lying on back and rolling	63,7±1,73	89.64±5,4
Sitting	27,94±0,72	69,19±5,35
Crawling and kneeling	13,7±2,83	52,19±5,99
Standing	13,7±0,04	45,5±7,45
Walking, running, and jumping	1,64±0,24	35,7±8,55
Goal total score	24,3±0,32	58,28±5,74

Table 3. *GROSS Motor Function Measurements (GMFM88) of 9-10 years old children with spastic diplegia) before and after rehabilitation*

Field (9-10 years old)	*Before rehabilitation*	*After rehabilitation*
Lying on the back and rolling	48.06±1,81	82.4±5,4
Sitting	27,94±0,72	66,19±5,35
Crawling and kneeling	13,7±2,83	49,19±6.46
Standing	12.16±1.21	40.35±12.48
Walking, running, and jumping	1.2±1.22	32.13±9.76
Goal total score	21,55±0,85	55.8±6.06

Table 4. *GROSS Motor Function Measurements (GMFM88) of 11-12- years old children with spastic diplegia) before and after rehabilitation*

Field (11-12 years old)	*Before rehabilitation*	*After rehabilitation*
Lying on the back and rolling	40.57±1,59	74.11±2.99
Sitting	22.61±2.33	64.14±6.36
Crawling and kneeling	12.43±3.35	45.63±4.92
Standing	11.97±3.56	39.34±3.45
Walking, running, and jumping	1.0±2.41	29.4±8.66
Goal total score	18.41±0,41	52.12±1.81

There was a difference between the corresponding quantitative indicators presented in percentages of qualitative characteristic data (1. Lying and rolling, 2. Sitting, 3. Crawling and kneeling, 4. Standing, 5. Walking, running, and jumping) according to age groups before treatment (I single-choice) and the corresponding quantitative indicators presented in percentages of qualitative characteristic data (1. Lying and rolling, 2. Sitting, 3. Crawling and kneeling, 4. Standing, 5. Walking, running, and jumping) according to age groups after 2 years of treatment (II single-choice). Gross motor function scores significantly increased in all age groups, especially in 5–6-year-old children.

When comparing the 5-6 age group and the 7-8 age group, statistical research showed that the difference before treatment was not significant in the third (crouching and kneeling) and fifth (walking) qualitative characteristics U>Ucr., (p >0.05). (Chart 1).

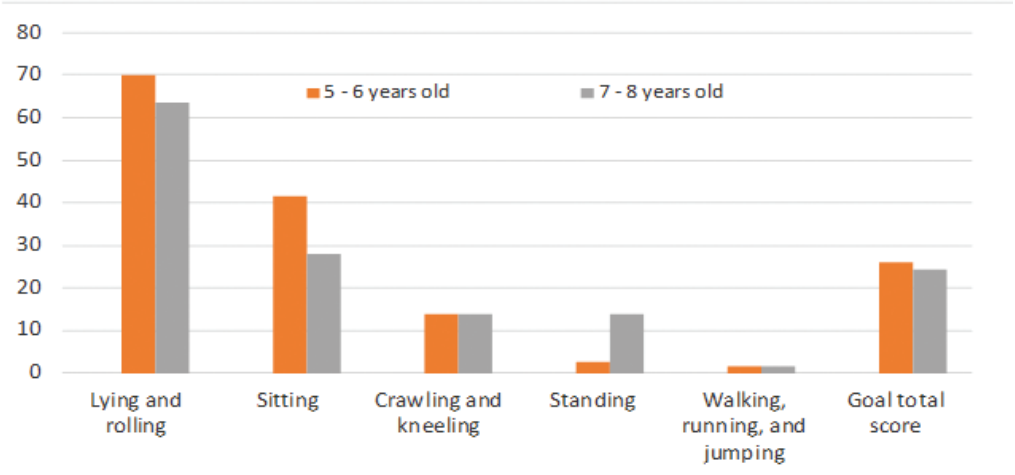

Chart 1. *Comparison of the qualitative characteristics of GMFM88 in 5- to 6- and 7- to 8-year-old children with spastic diplegia before treatment.*

After 2 years of treatment, the difference was significant in all six qualitative characteristics (P<0.05); the treatment gave better results in patients in the 5-6 age group than in patients in the 7-8 age group. (See Chart 2).

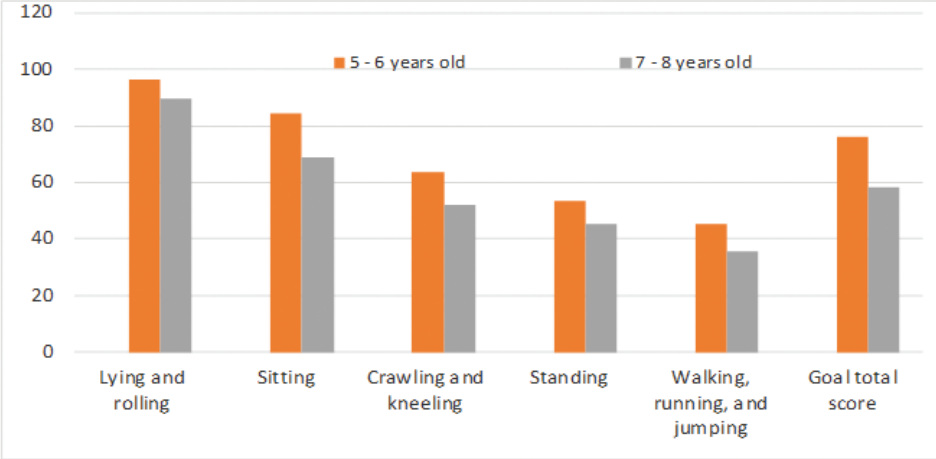

Chart 2. *Comparison of the qualitative characteristics of GMFM88 in 5- to 6- and 7 -to 8- year-old children with spastic diplegia two years after treatment*

When comparing the 7–8 age group and the 9–10 age group, the statistical study showed that before treatment, the difference was not significant in the second (sitting) U=22, the third (crouching and kneeling) qualitative characteristics U>Ukr., (p>0.05). (Chart 3)

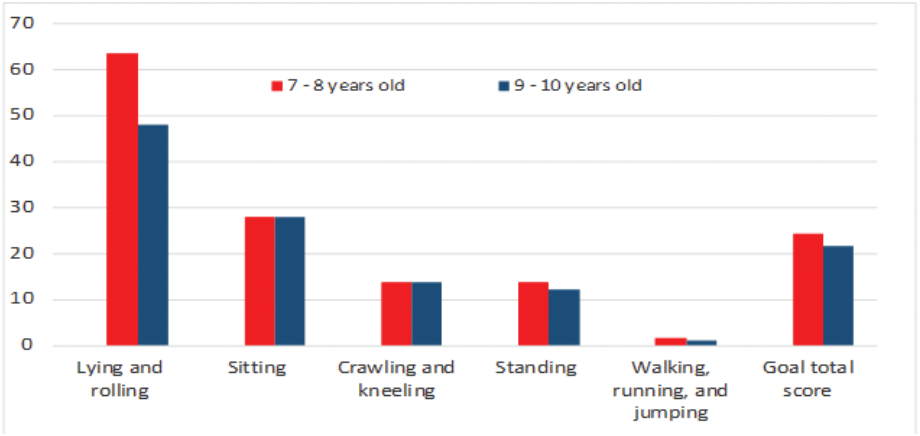

Chart 3. *Comparison of the qualitative characteristics of GMFM88 in 7- to 8- and 9- to 10- year-old children with spastic diplegia before treatment*

After 2 years of treatment, the difference in the data for all six qualitative characteristics was significant (P<0.05). (Chart4).

After 2 years of treatment, a small but better treatment result was noted in patients in the 7–8 age group than in patients in the 9–10 age group.

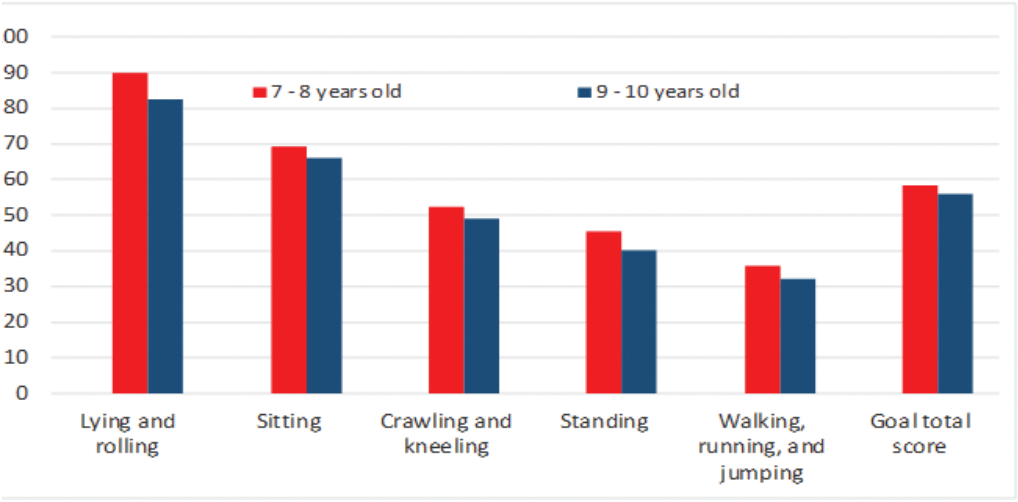

Chart 4. Comparison of the qualitative characteristic of *GMFM88* in 7- to 8- and 9- to 10- year-old children with spastic diplegia two years after treatment

When comparing the 9–10 age group and the 11–12 age group, statistical analysis showed that both before treatment and 2 years after treatment, the difference was significant for all six characteristics. The calculated U criterion value was less than the critical value of the U criterion (p <0.05). After 2 years, a better treatment outcome was observed in patients in the 9-10 age group than in patients in the 11–12 age group. (Chart 5)

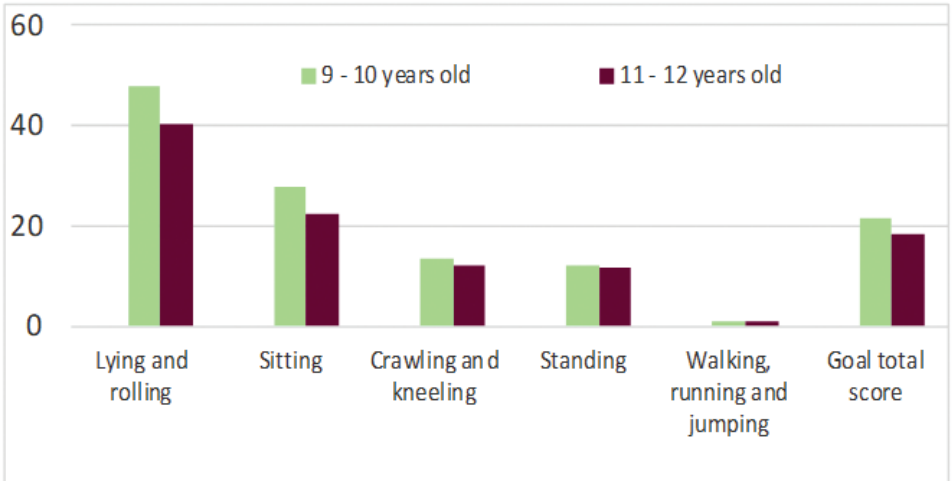

Chart 5. *Comparison of the qualitative characteristic of GMFM88 in 9- to 10- and 11- to 12- years-old children with spastic diplegia before treatment*

Children with spastic diplegia aged 11-12 years had less impaired standing and walking balance than children aged 9-10 years. (Chant 6)

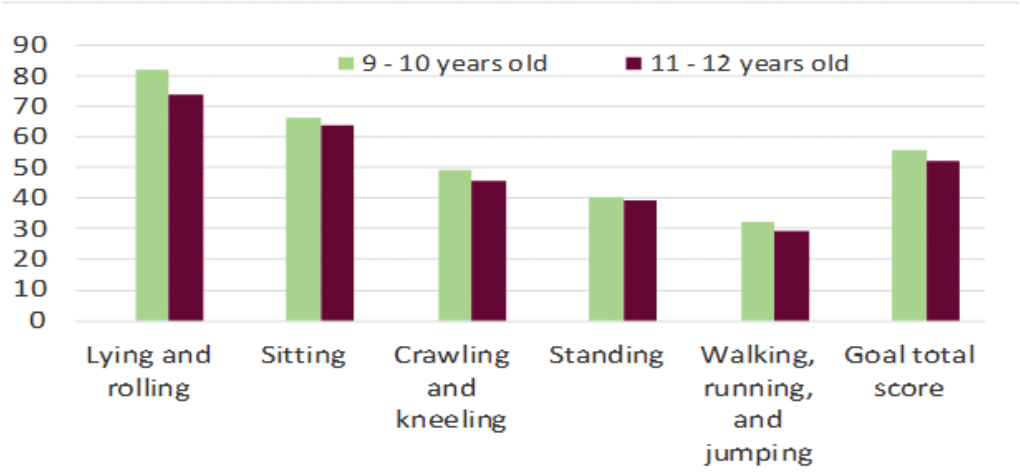

Chart 6. Comparison of the qualitative characteristic of GMFM88 in 9- to 10- and 11- to 12- year-old children with spastic diplegia two years after treatment

In conclusion, multidisciplinary rehabilitation in patients with spastic diplegia has shown good results. Particularly noticeable improvements were observed in 5–6-year-old children with spastic diplegia (standing and walking function particularly improved) (table 1). Standing and walking balance improved less in 7–8-year-old children compared to those of 5-6 years old ones (table2). Children with spastic diplegia aged 9-10 years had less impaired standing and walking balance than children aged 7-8 years (table 3). Children with spastic diplegia aged 11-12 years had less progress in treatment than children aged 5-10 years (table 4). Children with spastic diplegia aged 11-12 years had less impaired standing and walking balance than children aged 9-10 years. Physical therapy is one of the most important disciplines in the treatment of children with cerebral palsy. The primary goal of a physical therapy program is to minimize the effects of injury, reduce disability, and optimize function. Early intervention is important to prevent contractures and reduce muscle tone. Physical treatment is based on actions that help the patient in everyday activities. It is based on special manipulations that allow us to control abnormal movements from the central (trunk, abdomen, back) and proximal parts of the body (shoulders, pelvis). The emphasis is on correcting the proximal parts and the center of the body, thereby improving movement in the distal part. Of the theoretical issues, special importance is given to seven main issues, such as: Individualized treatment selection; Expanding the range of movement patterns; Preparing the child for any function needed at this particular stage of development; Preparing the parent to know how to behave when performing daily activities; Inhibiting abnormal patterns with controlled correct posture; Correcting the posture and movement of the proximal parts of the body achieves normal movement in the distal part; Learning through the sense of movement. The parents were given recommended exercises for use in the apartment. The greatest increase in the percentage of gross motor function measurements

was observed in the 5–6-year-old age group. This suggests that the younger the age at which the treatment course was started (384 procedures), the greater the percentage increase in the results of gross motor function measurements. Larger samples and longer follow-up data are needed to verify its long-term effectiveness. After completing the inpatient rehabilitation program, due to the low activity of outpatient rehabilitation, patients often experience a regression of the achieved results. It is necessary, if possible, to constantly accompany patients virtually because of the danger of "rolling back". The solution to this problem is the development and implementation of remote rehabilitation programs that will allow systematic and continuous medical care.

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РЕЗЮМЕ

ДЕТСКИЙ ЦЕРЕБРАЛЬНЫЙ ПАРАЛИЧ СО СПАСТИЧЕСКОЙ ДИПЛЕГИЕЙ: GMFM 88 ДО И ЧЕРЕЗ ДВА ГОДА ПОСЛЕ ФИЗИЧЕСКОЙ РЕАБИЛИТАЦИИ

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Спастическая диплегия (СПД) является второй по распространённости формой детского церебрального паралича. Целью исследования была оценка общей двигательной функции у детей со спастической диплегией до и после двухлетнего курса физической реабилитации. Исследование было проведено в Клинике медицинской реабилитации Университета Кена Уокера в Грузии. Функционирование клиники поддерживается в рамках проекта, финансируемого Агентством США по международному развитию (USAID), целью которого является развитие физической реабилитации в Грузии. Специалисты прошли полное профессиональное обучение под руководством экспертов Медицинской школы Университета Эмори. Всего в исследование был включён 31 ребенок со спастической диплегией в возрасте от 5 до 12 лет (включительно) до и после двухлетнего курса медицинской реабилитации. Дети были разделены на четыре возрастные группы: группа в возрасте 5-6 лет состояла из 8 пациентов; группа в возрасте 7-8 лет состояла из 8 пациентов; группа в возрасте 9-10 лет состояла из 8 пациентов, группа в возрасте 11-12 лет – из 7 пациентов. В исследовании для описания подвижности и двигательных навыков детей с церебральным параличом использовалась система для оценки крупных моторных (двигательных) навы-

ков – стандартизированный международный инструмент шкалу GMFM-88. В результате показатели общей двигательной функции значительно улучшились во всех возрастных группах, особенно у детей 5-6 лет. Эффективность традиционных физиотерапевтических вмешательств подтверждается увеличением объема движений во всех суставах нижних конечностей, снижением спастичности и улучшением функции равновесия.

Ключевые слова: детский церебральный паралич, спастическая диплегия, физиотерапия, реабилитация, шкала GMFM-88

რეზიუმე

სპასტიური დიპლეგიით ცერებრალური დამბლა: GMFM88 ბავშვებში ფიზიკურ რეაბილიტაციამდე და რეაბილიტაციიდან ორი წლის შემდეგ

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სპასტიური დიპლეგია (სდ), ცერებრალური დამბლის მეორე, ყველაზე გავრცელებული ფორმაა. კვლევა მიზნად ისახავდა დაავადებულ ბავშვებში მსხვილი მოტორული უნარების შეფასებას ფიზიკურ რეაბილიტაციამდე და კონვენციონალური ფიზიოთერაპიული ინტერვენციებით რეაბილიტაციიდან ორი წლის შემდეგ. კვლევა ჩატარდა კენ ვოლკერის სამედიცინო რეაბილიტაციის საუნივერსიტეტო კლინიკაში (საქართველო, თბილისი). კლინიკა ფუნქციონირებს ამერიკის შეერთებული შტატების საერთაშორისო განვითარების სააგენტოს (USAID) მიერ დაფინანსებული პროექტის ფარგლებში, რომლის მიზანია საქართველოში (თბილისი) ფიზიკური რეაბილიტაციის განვითარება. შეისწავლეს 5-დან 12 წლამდე (ინკლუზიური) სპასტიური დიპლეგიის მქონე 31 ბავშვის მდგომარეობა რეაბილიტაციამდე და ფიზიოთერაპიიდან ორი წლის შემდეგ. სპეციალისტებმა სრული პროფესიული კურსი გაიარეს და ტრენინგი ემორის უნივერსიტეტის სამედიცინო სკოლის ექსპერტებმა ჩაუტარეს. სპასტიური დიპლეგიის მქონე ბავშვები ოთხ ასაკობრივ ჯგუფში გადანაწილდა: 5-6 წლის - 8 პაციენტი; 7-8 წლის - 8 პაციენტი; 9-10 წლის - 8 პაციენტი და 11-12 წლის - 7 პაციენტი. ბავშვების მოტორული ფუნქციების მდგომარეობის შესაფასებლად მსხვილი მოტორული ფუნქციის კლასიფიკაციის სისტემა და სტანდარტიზებული საერთაშორისო საზომი GMFM-88 გამოიყენეს. ყურადღება გამახვილდა 5 ძირითად უნარზე: წოლა და გადაბრუნება; ჯდომა; ხოხვა და მუხლებზე დგომა; ფეხზე დგომა; და სიარული, სირბილი და ხტომა, რათა სწორად დაეგეგმათ მკურნალობის კურსი და ზუსტად შეეფასებინათ რეაბილიტაციის შედეგის ეფექტურობა. გამოსაკვლევ ბავშვებს ჩაუტარდათ ინტერდისციპლინარული სარეაბილიტაციო კურსი და რეაბილიტაციიდან ორი წლის შემდეგ, როგორც შედეგმა აჩვენა, GMFM88 მნიშვნელოვნად იყო გაუმჯობესებული ყველა ასაკობრივ ჯგუფში, განსაკუთრებით 5-6 წლის ბავშვებში. რეაბილიტაციის ეფექტურობა დადასტურდა ქვედა კიდურების ყველა სახსრის მოძრაობის ხარისხის გაუმჯობესებით, შემცირებული სპასტიურობით და წონასწორობის გაუმჯობესებით.

საკვანძო სიტყვები: ცერებრალური დამბლა, რეაბილიტაცია, მსხვილი მოტორული ფუნქცია, GMFM-88, სპასტიური დიპლეგია