

## **Predicting functional performance and locomotion of children with cerebral palsy**

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### **Abstract**

The aim of this study was to present the factors affecting prediction of the functioning and locomotion of children with cerebral palsy.

Cerebral palsy is one of the most common causes of disability among children. When predicting the future of a child, its functioning mode and locomotion, many factors should be considered, i.e. the degree of brain injury, the moment of implementing therapy, cognitive

abilities of the child, level of mental retardation, epileptic seizures, hearing and vision impairment, etc. The goal of the therapy and its effectiveness depends on the appropriate assessment, and this determines the prediction of the patient's future. The Gross Motor Function Classification System (GMFCS) can be a useful tool in predicting a child's functional performance.

**Keywords:**

CP, prediction

**Introduction**

Cerebral Palsy (CP) Latin name: *para lysis cerebralis infantium*, is one of the most common causes of disability in children. It is said to be "an umbrella" for numerous brain changes. *"It is believed that cerebral palsy is a collective term that includes persistent but changing through time, various disorders of muscle tone, motor activity, caused by damage to brain structures that regulate any human activities"* [1]. CP is a symptom complex that increases with age. The damage to the brain is irreversible. This syndrome does not progress, but its form changes. The occurrence of cerebral palsy is not fully understood. It is estimated that 2-3 children per 1000 newborns suffer from cerebral palsy (2-3‰). CP is more prevalent in boys than girls. It is caused by damage to the CNS (central nervous system). The number of damaged cells in the brain does not change, only the symptoms change along with the child's development. Damage may occur before birth (prenatal), during delivery (perinatal) or in the early period (up to two years) after birth (postnatal). The aim of this study was to present the factors affecting prediction of the functioning and locomotion of children with cerebral palsy.

**Diagnosis and motor development**

The pathogenesis of cerebral palsy is multifactorial. Disorders may occur very early and may be caused by genetic factors, factors that adversely affect the mother before conception, during delivery, after birth or during pregnancy. Parents of children with cerebral palsy often ask questions about the future of their children and they would like to hear specific answers, especially at early stages of the disease. Years later, they begin to understand that some questions have to be left unanswered or partially answered. The

diagnosis does not determine the motor abilities of the child, only specific clinical trials can determine the goals of therapy [2]. A variety of functional tests play an important role in this process and therapists responsible for the therapy plan are able to determine a precise short-term and long-term goal. This provides the opportunity to predict the functioning of a CP patient, and early prognosis enables effective therapy. The motor development of cerebral palsy patients is different and the clinical manifestation changes with age. Considering the form of cerebral palsy, there are various movement disorders and abnormal muscle tone, in a severe, medium or mild level. Achieving final motor capabilities depends on the damage level, method and intensity of treatment and the early onset of therapy.

### **The GMFCS scale**

The Gross Motor Function Classification System (GMFCS) is a tool useful in predicting child's motor development [3]. The scale is not predictive itself, but it can effectively help the therapist in some way to predict the child's possibilities regarding locomotion and future functioning. Proper qualification of a child to I to V functional level according to the GMFCS classification is crucial in physiotherapist's work. Due to proper qualification, some important aspects that determine the future of the patient can be predicted [4]. It is believed that a child has a possibility to reach higher level in the GMFCS classification in the future through intensive rehabilitation and favorable conditions, i.e. lack of serious coexisting diseases, orthopedic corrective surgeries - appropriate orthopedic equipment. Children classified in GMFCS level IV and V have lower chances of improvement. The improvement is also influenced by the child's age, i.e. the younger the child, the better the chance of therapy effectiveness. Unfortunately, patients will not manage to increase the functional level more than one level higher. However, the GMFCS scale is not itself a goal for the physiotherapist [3].

### **Therapy plan**

In determining the therapy, it is necessary to understand the child's needs globally and establish a plan considering the desire for maximum independence. For some children, the functional goal in the therapy plan will be, for example, appropriate selection of a lying position, so that it can play with a teddy bear or a doll. For others, the possibility to breathe

freely or tension normalization. For children with minor brain damage, the therapy plan may include, for example, improvement of running, gait dynamics, coping with difficulties, learning jumps, etc. [5]

### **Predicting - prognostic factors**

The prediction of the child's motor capabilities is significantly influenced by functional individual stages. If the child has severe limitations in head control until 8 months old, it will not obtain an independent sitting position in the future. The 24th month is also significant, because a child who until then does not obtain an independent sitting position, has no chance for independent walking in the future. Children who do not achieve stabilization of head and trunk before their 2<sup>nd</sup> birthday have no chance of independent standing. A child who does not crawl before their 3<sup>rd</sup> birthday, will not be able to transfer in higher movement position. A pattern of gait is formed until child's 8<sup>th</sup> birthday, therefore a child who does not walk until this period, will not probably walk alone.

In the examination and prognosis of the pediatric patient, age, its spontaneous behavior, emotions, muscular tension disorders, muscle and joint contractures, neurogenic scoliosis and abnormalities in the hip joints should be considered. All these aspects have an impact on predicting the future of the child [6,7].

Epileptic seizures, their quality and intensity also have an impact on the future of the patient. If they occur, they can significantly delay or slow down the effects of improvement. Drug-resistant epilepsy is particularly adverse, because it can significantly reverse the process of rehabilitation. The child's age, frequency, quality and type of epileptic seizures contribute to the effects of the rehabilitation process. It is expected that after the age of 15, epileptic seizures will stabilize or their number will decrease.

A proper care and regular changing positions is very important concerning patients with severe CP. It is recommended to change at least 2 positions within 24 hours. Supporting a lying child in accordance with his or her tolerance is extremely important.

Motion range Position	Abduction	Flexion	External rotation
Lying	15 - 30 degrees	10 - 40 degrees	5- 30 degrees
Sitting	15 - 30 degrees		5 - 15 degrees

Adequate positions during feeding can prevent aspiration pneumonia, which may occur as a result of passage of the food into the respiratory tract. For non-walking children, a control X-

ray of the hips is indicated once a year. These indications will affect positive prediction, i.e. reducing the effects of secondary structural changes. [8]

Achieving final motor capabilities depends on the damage level, method and intensity of treatment and the early onset of therapy. Children reach the peak of motor capabilities up to around 7-8 years of age. The fastest changes occur in children in level I and II of the GMFCS scale. In mild types of cerebral palsy, the prognosis is positive. The patients have a chance to improve the quality of movement patterns, inhibit incorrect compensatory patterns, and improve selective movements. In severe types of CP there is a risk of various complications, which is why they are burdened with a certain degree of doubtfulness. In all forms, complete recovery is impossible, but in some cases, mild forms, rehabilitation is so effective that it can significantly relieve almost all symptoms [9,10].

Another factor affecting prediction is adequate orthopedic equipment. Children can improve their postural control or locomotion functions, following recommendations for orthopedic equipment [7,11]. Children equipped with appropriate lower limb orthoses may gain significant postural control, which will affect the improvement of limb dissociation. Children usually have problems with dissociation of lower limbs due to insufficient postural control. The quality of movements of the pelvis, lower limbs and shoulder girdle among walking children is more or less disturbed. There is a possibility of improving the quality of selective movements by the automation of specific patterns. The proper position of the feet in the orthoses, determines the alteration of the support plane, which will in turn affect next higher-level joints. Physiotherapist can then focus on the quality of walking and independence of the patient, for example, energy efficiency increases, balance, endurance improves and the quality of walking is also changed.

In case of neurogenic scoliosis, it is necessary to take appropriate care and if needed, use an orthopedic suit (usually a dynamic suit) to prevent further deformation. The use of an orthopedic suit may result in inhibition of scoliosis progression. However, the withdrawal of scoliosis should not be expected, but only inhibition of its progress. It is necessary to monitor the orthopedic supply and change it regularly.

One of the factors positively affecting prediction is the daily upright mobilization of the patient (if there are no contraindications).

Benefits of upright mobilization:

- contracture prevention in the joints and incorrect structure of the hip joint,

- prevention of bone decalcification,
- improvement of blood circulation, intestinal motility, respiratory system,
- affect the well-being, enable better peer contact, which can also positively affect cognitive functions [12].

There are various dysfunctions related to cerebral palsy. They have a significant impact on the development of motor skills; one of them is spasticity which increases in neurogenic disorders. Increased tension occurs when stimulating the muscles, rather than inhibiting impulses to the muscles. Spasticity depends on the velocity rate of tonic reflex due to stretching. This is not caused by the limb itself, it is a secondary effect of damage to the central nervous system. The treatment of spasticity will not improve motor functions, due to a number of concomitant disorders [13].

Abnormal movement of children with cerebral palsy should be interpreted as damage to the neural network that will develop in a specified way and different time. This condition points out appropriate preventive actions in order to reduce postural defects. In case of children in level I of the GMFCS scale, early correction of the motor patterns will reduce or eliminate the effects of deficits. It will help to avoid disturbing the postural control system and postural defects. Due to therapeutic treatment, tension can be normalized and appropriate posture can be consolidated. Most of these children have the opportunity for full social harmony. Children with severe CP type, will require care for the rest of their lives. In such cases, prediction is not simple. Appropriate orthopedic equipment plays a major role in maintaining the range of motion and deformation prevention. By a reliable motor assessment of a child, further direction of development, mode of functioning and locomotion can be approximately determined. It is assumed that early diagnosis has a significant impact on the therapy effectiveness, which allows to identify disorders and to set therapy goals and directions. It is very important to monitor motor functions in the growth period during puberty. Although children with damaged central nervous system are born without deformation and contractures, they can appear later. It is not just the abnormal muscle tone that is responsible, but the lack of movement and maintaining the child in permanent positions, with no variations. [14,15,12].

Therapy with the Lokomat orthosis can be used in the process of learning and improving gait. Some researches [16] suggest that the Lokomat Orthosis positively influences gait parameters in all examined patients, particularly in children with bilateral spastic

paralysis. The device improves balance, changing positions, stable standing, stability of the trunk movement. Patients after this therapy are less likely to use orthopedic support while walking. It also improves the hip function in transfer phase, flexion and appropriate extension in the knee joint. Generally, rehabilitation supported by Lokomat orthosis can affect the quality of walking and thus the functioning of CP children.

Borkowska et al. suggest that predicting functioning and locomotion in CP patients is extremely difficult, because it consists of many factors. Parents understand at the beginning of the disease that some questions must remain unanswered. The cerebral palsy syndrome consists of motor disorders and co-existing symptoms such as visual and hearing impairment, mental retardation, speech and behavior disorders, perception disorders, epilepsy [12]. All these symptoms determine the development of disorders, which causes problems with predicting.

Personality of the child and parents and also their determination is very important. Behavior disorders are not a result of the brain injury itself, but also from the lack of right amount of movement, acceptance, love and safety [17].

Domagalska et al. [8] describe that disruptions caused by the CNS damage are difficult to predict. The brain plasticity is extremely valuable to the prognosis of the child's functioning, which can be described as an individual rehabilitative potential. The therapist must be up to date with the latest scientific research and be able to apply them according to the needs of the child and its family.

## **Conclusions**

Predicting the functioning and locomotion in cerebral palsy is extremely difficult because it consists of many factors. The functioning of children with cerebral palsy is affected not only by motor disorders but also by coexisting symptoms, such as visual disturbances, hearing disorders, mental disability, speech disorders, behavior and perception disorders, epilepsy and lack of orthopedic equipment. The degree of spastic paralysis can be a significant problem in achieving independent gait function [7]. Predicting functional performance is influenced by the child's motor functions, i.e. head movement control, independent sitting, creeping and crawling. The use of the GMFCS classification allows to determine a therapy plan and to influence the prognosis of the child's motor capabilities.

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