

## Original Article

### Ankle joint evaluation and rehabilitation at the cerebral palsied child

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#### Abstract

**Introduction:** Spastic cerebral palsy is the source for complex modification of the lower limb. Cerebral palsy is recognized like the most frequent cause of movement disability in child.

**Objective:** This study aimed to identify the changes due to rehabilitation therapy in a group of children with cerebral palsy.

**Materials and Methods:** We included in our study of 52 children with spastic CP, who were rehabilitated in a paediatric rehabilitation clinic. They were divided into either a rehabilitation therapy group (RG, n=28, with daily added kinotherapy and electrotherapy) or a control group (CG, n=24).

**Results:** The main concern of the therapy was the acquisition of independent walking. Our study demonstrate the significant progress regarding the effect of the therapy to the rehabilitation therapy group (RG) proved by the ROM of the ankle joint and GMFM ( $p < 0,05$ ) and there was not a significant difference between the groups in spasticity of the plantar flexors

**Conclusion:** We believe that these results after the application rehabilitation program show the progression in the acquisition of independent ambulation of cerebral palsied children.

**Key words:** spastic cerebral palsy, ankle joint, evaluation.

#### Introduction

Today many studies across the world recognize the cerebral palsy like the most frequent cause of movement disability in child population.

Cerebral palsy (CP) represents the prototype of disabilities due to the changes of normal development. By definition, the movement disturbances begin from the alterations in the development period of cerebral central system (Rosulescu et al., 2009). PC concern the gross and fine motor functions in variable degrees, the results being visible in the neuromotor development, specially the voluntary motricity and in the motor learning processes by the lack of experience (Liptak 2005). The motor acquisitions delayed or abnormal developed change of child capacity to explore and learn notions linked to the environment, with multiple motor and social consequences over the comportment and independence (Rosulescu et al., 2009).

The central neuromotor syndrome from CP determines some changes and patterns of exaggerated muscular activity like the spasticity. Spasticity and muscular hypotonia can coexist: in the former muscle imbalance produces shortening, or contracture of the stronger muscles, elongation of the weaker muscles, and restricted joint movement (Robson et al. 1971, Robson 1987). Sanger et all emphasize that in spasticity there is a basic difference between the passive state of muscle tone in the clinical examination and the impairment of voluntary movement that leads to the child's complaints (Sanger et al., 2003).

The diminishing of the increased muscular activity can by the central purpose in the therapy and in the improvement of the comfort, care and functionality to prevent the future musculoskeletal complications (Tilton 2006).

#### Therapeutic management

Management of the children with cerebral palsy requires an interdisciplinary approach that draws on the expertise of many specialists in different disciplines (Koman et al., 2004; Mathews et al., 1999; Czupryna et al., 2006). Infantile cerebral paralysis is a term familiar to neurologists, pediatricians, social workers and different persons from the public domain. The history of this disease has shown that there are big differences in concept

and approach with obvious implications on the evolution and prognosis, long or short term (Rosulescu et al., 2009).

In the rehabilitation process of children with CP, studies based on methods enabling objective assessment of complex motor phenomena are warranted (Czupryna et al 2006). „Most therapists work predominantly at an impairment level when trying to improve the functional possibilities of the child”. (Mayston 2001) Mayston consider that depending on the age of the child and severity of the disability, three general aims can be identified. Those are the increase or improve the skill repertoire, maintain functional level, general management and minimization of contractures and deformities (Mayston 2001). But the principal purpose of cerebral palsy child rehabilitation is to create the possibility of independent functioning across their life, and to create for them a possibility of independent functioning in their future lives (Ferrari A 2003).

However, because of the complexity of motor disturbances in these children and difficult to predict individual compensation capabilities, attempts of uniform classification of children with CP with regard to the gait pattern and in order to link specific therapeutic procedures to these patterns, failed (Czupryna et al 2006). Thus, individual approach remained that is based primarily on the understanding of the rules and mechanisms of the normal gait as well as the cause-effect approach to the pathological gait and recognition of the biomechanical phenomena in the described children in the context of phenomena of neuropathological nature (Czupryna et al 2006).

Numerous therapeutic interventions, including the non-traditional or complementar and alternative medicine are used widely by the families and professionals alike for their children with CP (Liptak 2005; Hurvitz et al. 2003; Mayston 2004).early intervention, interdisciplinary team approach and family focused intervention strategies are essential (Dilip 2005).

After the complex evaluation, the individual therapeutic plan is establish. The individualize treatment can include physical therapy, occupational therapy, oral medication, botox or phenol injections, intrathecal baclofen, selective dorsal rizotomy, orthopaedic surgery.

The successfully and early intervention for the treatment of muscular contracture can delay the need for surgical corrective therapy (Rosulescu et al., 2009) and in the traditional way, physical therapy and occupational therapy prove the efficacy in improving the functional abilities of the child with CP (Dilip 2005) by improving the muscular force and local muscular resistance, joint range of motions (Mayston 2004; Taggart et al 1999).

Usually when the cerebral palsy diagnose is communicated to the parents child (generally by the age of 18 month), the parents will is to know the severity of the malady and if the child will ever walk (Rosenbaum et al 2002).

The changes that appear to the lower limb level and in special to the leg and leg joints are frequent found in practice and are the most important challenges for the therapist and patient. Principally, these changes are generated by neurologic and orthopaedic changes that affect the ligaments, bone structure, muscles and tendons. Motricity disturbances and resulting leg deformities are frequently associated, so they must not be considerate in an isolate matter, the therapeutic approach must be considered in a holistic way.

So the most frequent deformities of the leg are the eversion or the inversion associated or not with equines, these associate various anomalies of the toes (toes in hammer, lateral deviations with halux valgus). The risk of deformities and the complications carry on to the adult individual.

The clinic examination has the purposes to evaluate functional disturbances and the existence of the fractures. The clinical assessment can be completed by tests like radiography, movement analyse, MRI, not always easy to access by the clinician and sometimes not accessible to the parents because of the increase costs necessary for the care of those children. The functional balance evaluation of the feet and lower limb need a clinical exam with inspection in rest and after weight bearing. Passive mobility joint evaluate the reduction of deformities and tries to trail a hipo-hiper-extension. Segmental motricity intend to discover the global motor reactions in different situations and movements, also are important the joint perception and skin sensibility.

Different assessment scales allow the evaluation of the level of independence of the movement on flat ground or with obstacles like *Gross Motor Function Classification System* - GMFCS (Russel 1989).

Must be mentioned the frequency of falling and the circumstances that release the fallings (if the foot droop stumble on obstacles or against of the other foot, the difficulty of sudden stop, the lateral sudden deviations) and their severity. Is also important the capacity of taking plantar support from sitting and must be also appreciated by the clinician the transfers and information's about the helping equipment or orthotic devises. The use of orthotic shoes to early or frequent changing reflects vicious attitudes on the leg support zones.

## Material and methods

We included in our study a total number of 52 children diagnosed with spastic CP that receives rehabilitation therapy in three paediatric rehabilitation clinics from Craiova, between 2005-2010 years. They were divided into either a rehabilitation therapy group (RG, n=28, with kinetotherapy and electrotherapy) or a control group (CG, n=24). The applied rehabilitation program consist of physical therapie exercises with passive and active joint

mobilization to facilitate the movement patterns, stretching exercises, also electrostimulation and laser therapy for plantar flexors muscles. The therapy was applied 5 days a week, for all the 24 months of our study for the children in RG, the children from CG for various reasons did not receive all the therapy sessions.

Spastic cerebral palsy is the source for complex modification on the leg, and we evaluate the changes of ankle joint in three moments (beginning T1, after 1 year T2, and at the end of our study, after two years T3) to demonstrate the role of rehabilitation in the life of cerebral palsy child.

The functional evaluation consists in the assessment of:

- **Range of motion.** We examine by goniometry the feet dorsiflexion. The passive tonus of lower limb muscles, considered the accurate reflex appreciation of the motor functions and not like a muscular analysis.

- **Modified Ashworth scale of muscle spasticity (Bohannon, 1987)** is considered an important clinical evaluation method of muscle spasticity as a rating scale to measure abnormality in tone or the resistance to passive movements in patients with neurological conditions.

- Gross motor evaluation was made with the **Gross Motor Function Measure GMFM-88 and GMFM-66 scoring**. The GMFM level represents the rate of motor function disability.

## Results

### **Ankle ROM evaluation for the spastic form of CP**

We calculated the mean for the 2 symmetric joint, then we calculate the general value for the lower spastic limb for each form of spastic cerebral palsy.

**Table 1.** Impact of ROM evaluation of the plantar dorsiflexion P after the evaluation program, standard deviation ST and mean difference, with CI95% confidence interval

Evaluation moment	ROM dorsiflexion P*	Studied Group (n=52)	
		RG (a, n=28)	CG (b, n=24)
T1	Mean ± SD	-4.3 ± 9	-3.9 ± 7.6
	TTEST (1,2) NS		
T2	Mean ± SD	-2.8 ± 8.8	-4.8 ± 7.7
	TTEST (1,2) NS		
Mean difference T2-T1 (CI 95%)		+1.4 (+0.2:+2.6)	-0.8 (-1.9:+0.3)
TTEST (1,2) NS			
T3	Mean ± SD	-2.5 ± 9.2	-5.2 ± 7.7
	TTEST (1,2) a:b<0,05		
Mean difference T3-T1 (CI 95%)		+1.8 (+0.3:+3.2)	-1.25 (-3.5:+1)
TTEST (1,2) a:b<0,05			

• plantar P extension/dorsiflexion deficit (in grades) with the sign (-), possible extension with (+)  
RG – rehabilitation therapy group, CG – control group, TTEST – significant difference between the two evaluated groups, NS – no significance

We observe that were not important statistical differences for the mean values of the plantar dorsiflexion between the 2 groups for all the evaluations. Significant statistical differences exist for the gain ROM acquisition values (difference between the calculated scores for T2 moment and the value of possible ROM dorsiflexion at the T1 moment) for the children with complex rehabilitation therapy RG after one year of therapy (+1.4, +0.2:+2.6) versus the CG (-0.8, -1.9:+0.3, p<0.05). The control lot present a decrease of plantar dorsiflexion of -0.8 grades during the first year of observation and evaluation.

After 2 years of rehabilitation, in the T3 moment, the children from RG present an increase of the dorsiflexion grade, distinctive superior (+1.8, +0.3:+3.2) comparing with the CG (-1.25, -3.5:+1, p<0.05), the children from the control group presenting at the end of our study a median decrease of plantar dorsiflexion with -1.25 grade.

We considered significant this parameter because the muscular hypertonia with the triceps retraction determine the reduction and the deficit of plantar dorsal flexion with the apparition of the equine leg, characteristic for the child with CP.

**Plantar flexors spasticity evaluation**

**Table 2.** Spasticity score for the plantar flexors muscles, standard derivation and the mean differences, with the confidence interval CI95%, between the evaluations

Evaluation moment	Modified Ashworth Score* of triceps sural muscle	Studied Group (n=52)	
		RG (a, n=28)	CG (b, n=24)
T1	Mean ± SD	2.61 ± 1.03	2.67 ± 1.00
	TTEST (1,2) NS		
T2	Mean ± SD	2.5 ± 1.13	2.63 ± 0.96
	TTEST (1,2) NS		
Mean difference T2-T1 (CI 95%)		0.11 (-0.22: 0.00)	-0.04 (-0.12:+0.04)
TTEST (1,2) NS			
T3	Mean ± SD	2.39 ± 1.16	2.58 ± 1.02
	TTEST (1,2) NS		
Mean difference T3-T1 (CI 95%)		-0.21 (-0.36:-0,06)	-0.08 (-0.19:+0.03)
TTEST (1,2) NS			

\* Modified Ashworth score

RG – rehabilitation therapy group, CG – control group, TTEST – significant difference between the two evaluated groups, NS – no significance

There was not a significant difference between the groups in spasticity of the plantar flexors, the difference between the T2-T1 moments (mean difference, CI 95%) for RG 0.11 (-0.22: 0.00) as opposed to CG values -0.04 (-0.12:+0.04) and with a mean difference at the moment T3-T2 for the RG subjects -0.21 (-0.36:-0,06) comparable with CG values of -0.08 (-0.19:+0.03)).

**Assessment of percentage score (%) of the GMFM sections in studied subjects**

After the percentile evaluation with GMFM, in all the 5 section of the scale, for all the patients with spastic form of CP, a total median value (percentile 25-75%) was made for all sections A - 86 (78-90), B- 53 (32-63), C - 60 (29-70), D – 36 (3-46), E -11 (0-15).

The bigger scores of GMFM were presented at the spastic hemiplegia patients, with the highest scores in all sections. Very reduce scores, even 0 for the sections regarding the walk and standing was discovered for the children with spastic tetraparesis.

**Table 3.** Average values of the GMFM score for all three assessments, standard deviation ST and mean difference with CI95% confidence interval between assessments

Evaluation moment	GMFM* Score	Studied Group (n=52)	
		RG (a, n=28)	CG (b, n=24)
T1	Media ± SD	47.8 ± 17	47.5 ± 16.6
	TTEST (1,2) NS		
T2	Media ± SD	51.8 ± 16.5	49.8 ± 15.8
	TTEST (1,2) NS		
Mean difference T2-T1 (CI 95%)		4 (2.5:5.4)	2.3 (1:3.6)
TTEST (1,2) a:b=0,05			
T3	Media ± SD	54.9± 16.6	51.3 ± 15.6
	TTEST (1,2) NS		
Mean difference T3-T1 (CI 95%)		7.1 (4.7:9.4)	3.8 (1.8:5.8)
TTEST (1,2) a:b<0,05			

\* Total Score % GMFM - Score % GMFM - codification 0-1-2-3

\*\*SECTION: A - lying & rolling (max 51, 100%), B - sitting (max 60, 100%), C - crawling & kneeling (max 42, 100%), D - standing (max 39, 100%), E - walking, running & jumping (max 72, 100%).

*RG – rehabilitation therapy group, CG – control group, TTEST – significant difference between the two evaluated groups, NS – no significance*

For the evaluated groups we didn't notice statistical differences between the average values of the gross motor skills using GMFM scale at the beginning of the study (RG  $47.8 \pm 17$ , CG  $47.5 \pm 16.6$ ).

After one year of therapy we notice an evident statistical difference between the two groups ( $p=0,05$ ), with the value of 4 (2.5:5.4) for the therapy group compared with children in the control group CG 2.3 (1:3.6).

At the end of our study, we notice statistically significant mean difference between the two groups (mean difference CI%95,  $p<0,05$ ) for GMFM score between T3 and T1, and more clear, expressed by increasing gross motor skills for the RG with a value of 7.1 (4.7:9.4) compared with GMFM value of CG 3.8 (1.8:5.8).

## Discussions

The goal of management of cerebral palsy is not to cure or to achieve normalcy but to increase functionality, improve capabilities, and sustain health in terms of locomotion, cognitive development, social interaction, and independence (Karen et al 2006).

The evaluation is very important to establish the individual therapeutic management plan necessary to each child.

It was concluded unequivocally that it does not exist a universal recipe that transfer and gait assessment in the management of treatment for all children with PC, is not only difficult but pointless (Le Métayer 1993).

Obviously, the problem of assessing gait in children with CP is complex and requires consideration of many aspects and sometimes the use of sophisticated and expensive devices. Thus, gait and motor development evaluation should be considered the most important aspects, which can beneficially influence the establishment of the rehabilitation program. Understanding and the ability to recognize the gait changes PC a application and properly used of common terminology, can facilitate communication and establish the most appropriate therapeutic decision.

Evaluation of multiple aspects of child with PC walking helps determine individual therapeutic decision, including those on botulinum toxin, selecting the most suitable type of orthopedic footwear, orthoses, select the type of surgery and in the final determination of accents and even the choice of physiotherapy techniques aimed to minimize the source of the observed anomaly.

Assessment of gait allows changes recognition occurring during and after various therapies and to evaluate the effects of the dramatic and remote recovery. Selection of appropriate assessment techniques with competence in interpreting the results is also required.

## Conclusions

Our study demonstrate the significant progress regarding the effect of the therapy to the rehabilitation therapy group (RG) proved by the ROM and GMFM evaluation and not a significant effects of the rehabilitation program over the spasticity of the ankle joint.

The rehabilitation specialist must state the best methods and techniques applied in the rehabilitation program in accordance with neuromotor status and associated diseases of children, to establish the optimal duration and rate of recovery session, given that the fundamental objectives of the program to children with PC, as spastic include combat/reduce/control leg muscle spasticity, maintain/improve the recovery of the amplitude of movement and motor control with the ability to make adjustments in posture and adjust the dynamic movements of the trunk and limbs to walk as a correct habit.

Therapeutic choice must take account of peer collaboration and cooperation in the social context in which the patient is located. Supervision and care should be lifelong patient.

In the process of recovery / rehabilitation complex must use all methods include physical therapy, physiotherapy, electrotherapy and hydrokinetotherapy whose effects are extremely useful both in combat spasticity, spastic muscle tone antagonists, tissue recovery flexibility (because of contractures that are installed) with beneficial effects on the same neuropathological and functional links.

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