GROSS MOTOR FUNCTION CLASSIFICATION SYSTEM AND MANUAL ABILITY CLASSIFICATION IN CEREBRAL PALSY EVALUATION

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ABSTRACT

Cerebral palsy (CP) is a chronically cerebral disease, which is defined like a group of non-progressives motor diseases that onset in the first year of life and are the secondary lesions for a developed brain. At pediatric age CP is the most frequent cause of severe and infirmity motor problems.
Aim of the study. Comparative framing in various degrees of severity for CP at child applying two classifications: *Gross Motor Function Classification System* (GMFCS) and *Manual Ability Classification System* (MACS).
Material and Methods. The study group included 129 children (43 girls and 86 boys) aged 2-18 years, diagnosed with various forms of CP. The study protocol included general clinical examination, neurological exam.
Results. Of patients with CP watch, 24 (18,60%) were employed in both the grade I classification GMFCS and MACS. Also, of the 69 children who could walk independently (GMFCS I+II), 60 had good manual dexterity or very good (MACS I+II). Of the 35 patients with severe forms of PC (GMFCS V), 32 could not wield the objects being impressed into MACS V and 3 could handle only certain items being included in MACS IV.
Conclusions. The gross motor function and the manual ability evolve on different levels of severity depending on type of CP. In diskinetic CP, ataxic CP and mixed forms of CP was noticed a higher correlation between the grades of the two classifications.

Keywords: cerebral palsy, motor function, manual ability, child

Cerebral palsy is a chronically cerebral disease, which is defined like a group of non-progressives motor diseases that onset in the first year of life and are the secondary lesions for a developed brain. Cerebral palsy (CP) represent for child an important health problem, many studies reported a prevalence of 1-2,4 cases/1000 newborn (1). At pediatric age CP is the most frequent cause of severe and infirmity motor problems.

The aim of this study was comparative framing in various degrees of severity for CP at child applying two classifications: *Gross Motor Function Classification System* (GMFCS) and *Manual Ability Classification System* (MACS).

MATERIAL AND METHODS

The study group included 129 children (43 girls and 86 boys) aged 2-18 years, diagnosed with various forms of CP in the Department of Pediatric Neurology of "Santa Maria" Emergency Hospital for Children in the 2007-2013 period. All parents signed informed consent. Classification of CP was done according to the proposal Surveillance of Cerebral Palsy in Europe Group since 2000 (2). 114 (89.37%) children were diagnosed with spastic forms, 8 (6.2%) with CP dyskinetic 5 (3.87%) with CP ataxic and 2 (0.56%) with mixed CP. Of the 114 patients enrolled, 73 (64.03%) met diagnostic criteria for bilateral spastic CP (39 children with spastic diplegia, 34 children with spastic quadriplegia) and 41 (35.97%) for spastic unilateral CP (37 children with hemiplegia, 4 children with monoplegia).

The study protocol included general clinical examination, neurological exam. For a description of the motor function in children with CP was used *Gross Motor Function Classification System* (GMFCS) described by Palisano (3) in 1997 and *Manual Ability Classification System* (MACS) described by Eliasson (4) in 2006. Using GMFCS evaluated for each individual patient, the presence, amplitude and strength of active movements, especially walking, in the grade I being assigned patients that the active movements are carried out without major re-

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strictions while in the V grade were included children who do not have the capacity to move, being completely immobilized (Table 1). Using MACS, was evaluated how children with CP enrolled in the study, uses their upper limbs to manipulate various objects in daily activities. Within the MACS grade I, have been enrolled patients with a good manual skill, and to the V grade, childrens with no active manual function (Table 1).

TABLE 1. *Classification criteria for Gross Motor Function Classification System (Palisano, 1997) and Manual Ability Classification System (Eliasson, 2006).*

GMFCS	MACS
GMFCS I independent walk, without any restrictions, but there are difficulties in coarse advanced movements	MACS I handles objects easily, accurately and successfully
GMFCS II independent walk, but with the restriction of outdoors activities	MACS II can handle most things, but there is some reduction in the quality of its grip or speed
GMFCS III walking possible with support, with the restriction of outdoors activities	MACS III manipulates objects with difficulty, needs help in preparing or modifying activities
GMFCS IV impossible walking, global mobility limitation	MACS IV can handle only certain objects which are handy and only in certain situations
GMFCS V impossible walking with important limitation of global mobility	MACS V can't handle objects and has limited abilities, even in simple measures

GMFCS = *Gross Motor Function Classification System*,
MACS = *Manual Ability Classification System*.

RESULTS

For each child with cerebral palsy was determined at the same age and degree GMFCS MACS and an attempt was made to establish a correlation between the level of manual dexterity and the level of gross motor function. Of patients with CP watch, 24 (18.60%) were employed in both the grade I classification GMFCS and MACS. Also, of the 69 children who could walk independently (GMFCS I+II), 60 had good manual dexterity or very good (MACS I+II). Of the 35 patients with severe forms of PC (GMFCS V), 32 could not wield the objects being impressed into MACS V and 3 could handle only certain items being included in MACS IV (Table 2).

It was also tried making a correlation between the form of cerebral palsy and GMFCS classifications and MACS (Table 3).

TABLE 2. *The correlation between Gross Motor Function Classification System and Manual Ability Classification System in children with cerebral palsy*

GMFCS	MACS				
	Level I	Level II	Level III	Level IV	Level V
Level I	24 (18,58%)	13 (10,10%)	1 (0,78%)	-	-
Level II	8 (6,20%)	15 (11,63%)	8 (6,20%)	-	-
Level III	3 (2,33%)	2 (1,55%)	2 (1,55%)	2 (1,55%)	-
Level IV	2 (1,55%)	3 (2,33%)	3 (2,33%)	6 (4,64%)	2 (1,55%)
Level V	–	–	–	3 (2,33%)	32 (24,8%)

GMFCS = Gross Motor Function Classification System,
MACS = Manual Ability Classification System.

DISCUSSION

Determination and periodical evaluation of neuromuscular function in children with CP is essential for establishing neurological rehabilitation plan (5). Currently there are numerous methods for evaluating gross motor function, gait and manual ability in these patients. *Gross Motor Function Classification System* is clinically valuable in assessing children with CP, representing a reliable scale of appreciation of the severity motor deficit (5). Also, *Manual Ability Classification System* constitutes an important method for assessing the degree of use of upper limb because the gross motor function in CP and the manual ability are not equivalent. Upper limb function depends largely on cognitive skills and voluntary motor control, there are often significant differences between maximum capacity and spontaneous performance, between what the children can do and what he wants to do (6).

In our study all patients with monoplegia motor deficit was affect a lower limb, being employed in GMFCS grade I, and the ability to use the upper limbs was not affected. In children with spastic hemiplegia noted that manual ability was more affected than the gross motor function. Of these patients, according to GMFCS classification, 19 (51.35%) could walk independently without any restrictions in both the external environment and inside, being included in the GMFCS grade I, and 9 (24.32%) of them could easily handle objects being employed in MACS I. Seven (18.92%) patients with spastic unilateral CP needed help in handling objects (MACS III and IV). In the group of children with spastic bilateral CP both gross motor function and manual dexterity, varied greatly from one form to another. Thus, it has been observed that patients with spastic diplegia gross motor function was more affected than children's ability to handle objects. For example, of the 9 patients with spastic

TABLE 3. *Classification of children with cerebral palsy depending on the classification system Gross Motor Function Classification System and Manual Ability Classification System*

GMFCS	Nr.	MACS				
		Grade I	Grade II	Grade III	Grade IV	Grade V
Monoplegia						
Grade I	4	4(100%)	–	–	–	–
Spastic hemiplegia	37					
Grade I	19	9 (24,32%)	10 (27,03%)	–	–	–
Grade II	17	–	11 (29,73%)	6 (16,22%)	–	–
Grade III	1	–	–	–	1 (2,70%)	–
Grade IV	–	–	–	–	–	–
Grade V	–	–	–	–	–	–
Spastic diplegia	39					
Grade I	11	8 (20,53%)	2 (5,13%)	1 (2,56%)	–	–
Grade II	12	7 (17,95%)	3 (3,79%)	2 (5,13%)	–	–
Grade III	7	3 (7,69%)	2 (5,13%)	1 (2,56%)	1 (2,56%)	–
Grade IV	9	1 (2,56%)	2 (5,13%)	3 (7,69%)	3 (7,69%)	–
Grade V	–	–	–	–	–	–
Spastic quadriplegia	34					
Grade I	–	–	–	–	–	–
Grade II	–	–	–	–	–	–
Grade III	–	–	–	–	–	–
Grade IV	2	–	–	–	1 (2,94%)	1 (2,94%)
Grade V	32	–	–	–	1 (2,94%)	31 (91,18%)
Dyskinetic CP	8					
Grade I	1	1 (12,5%)	–	–	–	–
Grade II	1	–	1 (12,5%)	–	–	–
Grade III	1	–	–	1 (12,5%)	–	–
Grade IV	3	–	–	–	2 (25%)	1 (12,5%)
Grade V	2	–	–	–	1 (12,5%)	1 (12,5%)
Ataxic CP	5					
Grade I	3	2 (40%)	1 (20%)	–	–	–
Grade II	1	1 (20%)	–	–	–	–
Grade III	–	–	–	–	–	–
Grade IV	1	–	–	–	1 (20%)	–
Grade V	–	–	–	–	–	–
Mixt CP	2					
Grade I	–	–	–	–	–	–
Grade II	–	–	–	–	–	–
Grade III	–	–	–	–	–	–
Grade IV	1	–	–	–	1 (50%)	–
Grade V	1	–	–	–	1 (50%)	–

GMFCS = *Gross Motor Function Classification System*, MACS = *Manual Ability Classification System*.

diplegia, which they could not move included in the GMFCS IV, 5 (55.55%) could handle without help objects being included in grade I or II MACS. All those 34 children with spastic quadriplegia lacked movement capacity (GMFCS IV+V), and 32 of them had not used the upper limbs, with limited abilities even in simple measures. In patients with diskinetic CP was noticed a higher correlation between the grades of the two classifications. Such of these children, 62.5% were presented global mobility limitation (GMFCS IV+V) and limited manual skills (MACS IV, V). In our study children with ataxic CP and those with mixt CP form represented a small group of patients. Most patients with ataxic CP had good motor function, 4 (80%) being included in grade I/II in the classification of GMFCS and MACS. Two children with mixed forms of CP had severely impaired motor function, being included in the GMFCS grade IV/V and MACS IV.

All these data are similar to those reported in the literature and supporting the conclusion of Menkes (2006) (1) that both gross motor function impairment and the skills of handling objects are different depending on the type of CP. Studying the relationship between topography and degree of motor deficit Caram (2006) (7) observed that the majority of children with spastic hemiplegia falls into Grade I GMFCS, noting that motor deficit of hemiplegics

patients is generally of grade I, II or III. Many authors have noted that children with spastic diplegia falls generally within the first few levels of the classification GMFCS. For example, Pfeifer (2009) (8) has not employed any patient with diplegia in grade V, the same results being found in Caram's study since we (2006) (7) which included the majority of children with diplegia in particular in the first three degrees of the GMFCS classification and only 5% in GMFCS type IV. Patients with spastic quadriplegia presents generally severe forms of CP. Beckung (2008) (9) has placed on all children with spastic quadriplegia in GMFCS grade V, classification of those with dyskinetic CP included cases from grade I to V, and the majority of the ataxic forms of CP were included in grade III. Himmelmann (2005) (10) declared similar results in which patients with quadriplegia have been employed at level IV and V, and most people with dyskinesia at level IV and V. Caram (2006) (7) reported that most children tracked with quadriplegia had serious forms of CP (grade IV, V GMFCS), those with dyskinesia were included in level II, III or IV and those with ataxic CP were classified in the first three groups of *Gross Motor Function Classification System.*

CONCLUSIONS

In children with cerebral palsy the gross motor function and the manual ability are not equivalent. The correlation between gross motor function and the manual ability depends of type of cerebral palsy. In patients with diskinetic cerebral palsy, ataxic cerebral palsy and mixed forms of cerebral palsy was noticed a higher correlation between the grades of the two classifications.

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