

## MUSCLE STRENGTH EXAMINATION OF HAND AND MOTOR SKILLS OF HAND IN CEREBRAL PALSY

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### Abstract

The aim of this study is an evaluation of the results of The Manual Ability Classification System (MACS), Gross Motor Function Classification System (GMFCS), and muscle strength examination measured by dynamometer in children with cerebral palsy. We examined 51 patients with cerebral palsy in the age ranging from 8 years to 26 years (average age  $17.3 \pm 4.2$ ) living in the Home for Handicapped Children and Young Adults, Kociánka, Brno. The group consisted of 28 girls and 23 boys.

Maximum handgrip was measured by a hand dynamometer in both upper extremities. After the examination by a physiotherapist the patients were categorised according to their gross motor skills using the Gross Motor Function Classification System (GMFCS) and fine motor skills using the Manual Ability Classification System (MACS). Muscle strength in the better hand in the whole group ranged from 34 to 442 N (average  $235.8 \pm 85.9$ ), in the other hand from 5 to 376 N (average  $66.7 \pm 66.2$ ). The results show a weak correlation between the muscle strength of the handgrip and MACS, but it is statistically significant ( $R = 0.342$ ;  $p < 0.05$ ), correlation between the muscle strength of the handgrip and GMFCS does not exist.

### Key words

Cerebral palsy, Dynamometry, Gross Motor Function Classification System, The Manual Ability Classification System

### INTRODUCTION

International Classification of Functioning is a document of the WHO directing our attention in the assessment of patients mainly to functional abilities and possibilities of participation in society (1).

The Gross Motor Function Classification System (GMFCS) is an important instrument for evaluation of gross motor skills in children with cerebral palsy (DMO) within the framework of their common functions. Recently, the Manual Ability Classification System (MACS) has been developed as a relevant method of classification for evaluation of fine motor skills of the hand in DMO (2, 3). The test

evaluates fine motor skills by the technique already used in GMFCS. In another aspect, both classification systems are also important for Evidence-based Practice because easy scoring and quick realisation enable a common language to be established both for professionals and for parents of children included in a very heterogeneous group of DMO (4). Childhood cerebral palsy involves a diversified group of patients with long-time demands on rehabilitation. The characteristics of DMO are different in individual papers. The group for the research of DMO in Europe Surveillance of Cerebral Palsy in Europe recommends the DMO syndrome to be characterised as follows: It is the category of permanent, but not unchangeable disorders of motion and/or posture and motor functions, evolving on the basis of non-progressive disturbance, lesion or abnormality of the developing immature brain (5).

#### AIM

The aim of this study is an evaluation of the results of the Manual Ability Classification System (MACS), Gross Motor Function Classification System (GMFCS), and muscle strength examination measured by dynamometer in children with cerebral palsy.

#### METHODS

##### **Set of patients**

We examined 51 patients with DMO in the age ranging from 8 years to 26 years and 8 months (average age  $17.3 \pm 4.2$ ). Eight patients were at the age of 8–12 years, 20 patients were at the age of 12–18 years, and 23 patients were older than 18 years. The set consisted of 28 girls and 23 boys. The subtypes of DMO were determined according to the classification of Mr. and Mrs. Bobath.

The patients with DMO suffered from the spastic form in 47 cases; in 10 patients it was hemiparesis, in 18 patients diparesis, in 3 patients triparesis, in 16 patients quadraparesis, in 1 patient ataxic form, in 3 patients dyskinetic form. All patients are in charge of the Home for Handicapped Children and Young Adults, Kociánka in Brno.

##### **GMFCS and MACS tests**

Functional test for evaluation of fine motor skills in DMO: The patients were included, according to functional skills of the hand, on the basis of observation of a physiotherapist in one of 5 levels of MACS (5th level means the most serious disablement). This classification is focused on skills performed by the patient in usual daily life; it should not serve for evaluation of the maximum potential. It evaluates the common work of both hands.

In the scale of the GMFCS test of gross motor functions the examined patients were included in one of five levels characterising in the best way their gross motor skills in the usual environment on the basis of observation of a physiotherapist (5 meaning the most serious disablement). This system evaluates gross motor functions on the basis of initiation of motion stressing the sitting position, movements, and mobility. The differences between the groups are given by limitations, by the necessity of using aids or wheelchair, and by reduced quality of motion (2).

The maximum handgrip was measured by a hand dynamometer, first on the upper extremity with a lesser motor disablement, and then on the other upper extremity. The examined patients were sitting on a chair or a wheelchair during the measurement. The upper extremity was not supported, the arm was in adduction close to the body, flexion in elbow  $90^\circ$ , central position of forearm and wrist. The position of some patients was modified because of contractures.

## RESULTS

### GMFCS and MACS Tests

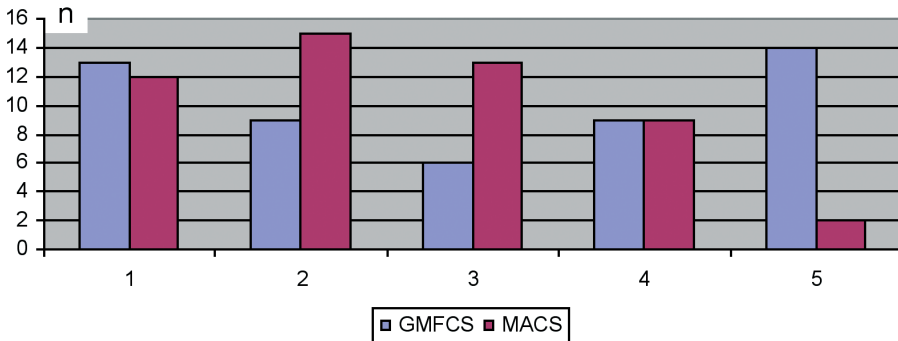
All 51 patients with DMO were included in functional levels 1-5 according to the GMFCS test of gross motor functions. We assessed the score of the MACS functional test for evaluation of fine motor skills of the hand and muscle strength of dominant and non-dominant upper extremities in patients with DMO.

*Table 1*

Correlation of the test of fine motor skills (MACS) and of the test of gross motor skills (GMFCS) in patients with cerebral palsy

GMFCS levels	MACS levels					TOTAL
	I	II	III	IV	V	
I	8	5	-	-	-	13
II	2	2	2	-	-	6
III	2	4	2	-	-	8
IV	-	1	2	-	-	3
V	-	-	11	8	2	21
TOTAL	12	12	17	8	2	51

Distribution of the group into individual categories of gross motor skills (according to GMFCS) and fine motor skills (according to MACS) is shown in *Table 1* and *Graph 1*.



*Graph 1*

Results of the test of Gross Motor Skills (GMFCS) and of the test of fine motor skills (MACS) in patients with cerebral palsy

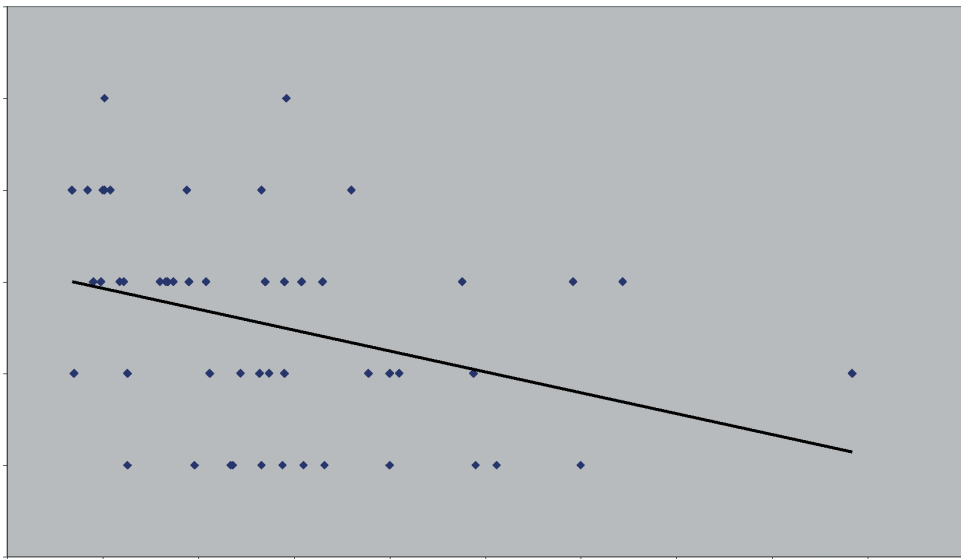
n - number of patients, category of GMFCS or MACS in points of scale

Fourteen patients with DMO (27%) had better results in MACS, conformity in both tests was in 30 patients (59%), 7 patients (14%) had better results in GMFCS. It means that GMFCS does not correlate with MACS in 73% of the patients.

#### Muscle strength in patients with DMO

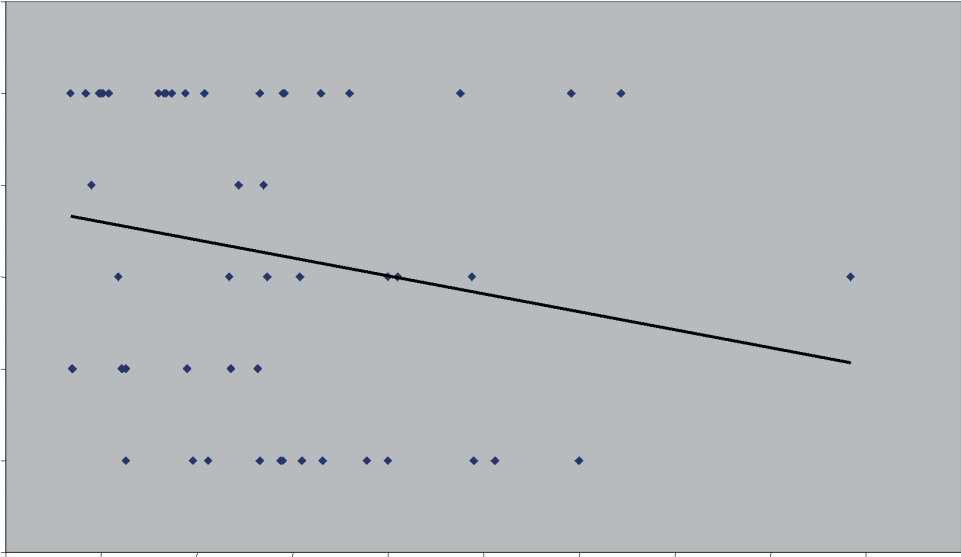
Muscle strength of the hand with a lesser disablement in the whole set was in the range from 34 to 442 N (average  $235.8 \pm 85.9$ ), muscle strength of the other hand was in the range from 5 to 376 N (average  $66.7 \pm 66.2$ ). The relationship between muscle strength of the hand with a lesser disablement and functional ability of the hand according to MACS can be seen on *Graph 2* and the relationship between muscle strength and GMFCS is represented on *Graph 3*.

The correlation between muscle strength of the hand and MACS is low, but statistically significant ( $R= 0.342$ ;  $p < 0.05$ ); there is no correlation between muscle strength and GMFCS.



*Graph 2*

Relationship between muscle strength of the hand with a lesser disablement and functional ability of the hand according to MACS



*Graph 3*

Relationship between muscle strength of the hand with a lesser disablement and functional ability of the hand according to GMFCS

#### DISCUSSION

The test MACS serving for elimination of the influence of gross motor skill disorders places emphasis on handling things in personal space of the examined patient. Eliasson et al. gives the intrinsic coefficient of correlation in the observer group of physiotherapists 0.97, in the observer group parents - physiotherapists 0.96 (3).

We expected that the correlation between handgrip and motor tests would be low. We thus confirmed the assumption that measurement of strength cannot serve even for a rough estimate of the level of disablement.

Beckung and Hagberg in their study also dealt with the function of the hand in DMO; they used, however, the Bimanual Fine Motor Function (BFMF) test for evaluation, which cannot be compared either with the score of the MACS functional test for evaluation of fine motor skills of the hand in patients with DMO or with examination of muscle strength measured by dynamometer, and its reliability has not yet been tested. BFMF is directed more at the disorder, while MACS more at the activity (6).

When evaluating GMFM and MACS in individual patients with DMO, we arrived at similar results as Carnahan et al. in the study of the relation of GMFCS to MACS. These authors found conformity between MACS and GMFCS in 53% of patients, MACS better than GMFCS in 20% of patients, and GMFCS better than MACS in 27% of patients (7). This leads to the same conclusions as our study.

The score of the MACS functional test for evaluation of fine motor skills of the hand in DMO describes very well the functional state of the child with DMO. This evaluation can be used for improving the quality of communication between professionals and the parents of these children. It is also evident, however, that the function arises from the organ; nevertheless, a mere description of the state of the organ, e.g. muscle strength measured by a dynamometer, does not give a clear picture of the patient in such a varied group as DMO.

#### A c k n o w l e d g e m e n t

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