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Evaluation of the Relation Between Hand Functions and Severity of Cerebral Palsy

Serebral Palsi Şiddeti ile El Fonksiyonları Arasındaki İlişkinin Değerlendirilmesi

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Summary

Objective: Several scales had been developed to evaluate upper extremity function in patients with cerebral palsy (CP). One of these scales is the Manual Ability Classification System (MACS) which evaluates the manual ability of children with CP in daily activities. MACS aims to assess the level of the child's usual performance, not to classify best capacitiy. Likewise, the Bimanual Fine Motor Function (BFMF) scale determines both hand functions together. In this study, we aimed to determine the relationship between CP severity and hand functions in children with CP.

Materials and Methods: We included a total of 87 children with CP patients hospitalized in our CP unit. Hand functions were assessed with the MACS and the BFMF scales, whereas the CP severity was evaluated with the Gross Motor Function Classification System (GMFCS).

Results: The mean of age of the patients was 6.93±1.93 (4 to 13) years. 40 children (46.0%) were diplegic, 3 (3.4%) - hemiplegic, 9 (10.3%) - tetraplegic, 9 - (10.3) ataxic - 5 (5.7%) - dyskinetic and 21patients (24.1%) were with mixed-type CP. A positive strong correlation was found between the BFMF ile the MACS. The patients were divided into two groups: group 1 consisted of patients with diplegic, hemiplegic and mixed CP, while group 2 included ataxic, dyskinetic and mixed CP. In both groups, a positive correlation was found either between the GMFCS and the MACS or between the GMFCS and the BFMF scales The patients were divided into two groups: group 1 consisted of patients with diplegic, hemiplegic and mixed CP, while group 2 included ataxic, dyskinetic and mixed CP. In both groups, a positive correlation was found either between the GMFCS and the MACS or between the GMFCS and the BFMF scales. On the other hand, in group 2 both the correlation between GMFCS and MACS and the correlation between GMFCS and BFMF were found to be stronger than that of Group 1.

Conclusion: Based on the results of this study, in assessing the manual functions of CP children, the MACS and the BFMF are compatible scales with each other and with GMFCS as well. *Turk J Phys Med Rehab 2013;59:18-25.*

Key Words: Cerebral palsy, hand functions, gross motor function

Özet

Amaç: Serebral palsili (SP) hastalarda üst ekstremite fonksiyonlarını değerlendirmek amacıyla çeşitli ölçekler geliştirilmiştir. Bu ölçeklerden biri olan Manual Ability Classification System (MACS) SP'li çocukların günlük yaşam aktiviteleri sırasındaki her iki el fonksiyonlarını birlikte değerlendirir. Amaç maksimum kapasiteyi değil, el performansını belirlemektir. Benzer şekilde Bimanual Fine Motor Function (BFMF) da her iki el fonksiyonunu birlikte değerlendirir. Bu çalışmada SP'li çocukların el fonksiyonları ile SP şiddeti arasındaki ilişki araştırılmıştır.

Gereç ve Yöntem: Hastanemiz SP ünitesinde yatarak rehabilitasyon programı uygulanan 87 SP'li çocuk çalışmaya alındı. El fonksiyonları MACS ve BFMF ile, SP şiddeti ise Gross Motor Function Classification System (GMFCS) ile d eğerlendirildi.

Bulgular: Hastaların yaş ortalaması 6,93±1,93 (4-13) yıldı. SP tipine göre hastaların 40'ı (%46) diplejik, 3'ü (%3,4) hemiplejik, 9'u (%10,3) tetraplejik, 9'u (%10,3) ataksik, 5'i (%5,7) diskinetik ve 21'i (%24,1) mikst tipte idi. BFMF ile MACS ve arasındaki pozitif güçlü korelasyon saptandı. Hastalar diplejik, hemiplejik, total tip grup 1 ve ataksik, diskinetik, mikst tip grup 2 olarak iki gruba ayrıldı. Her iki grupta GMFCS ile MACS ve GMFCS ile BFMF arasındaki ilişki incelendiğinde GMFCS ile her iki ölçek arasında anlamlı pozitif korelasyon saptandı. Ancak grup 2'de GMFCS ve MACS, GMFCS ve BFMF arasındaki ilişkinin daha güçlü olduğu belirlendi.

Sonuç: Bu çalışmanın verilerine göre MACS ve BFMF, SP'li çocuklarda el fonksiyonlarını değerlendirmede birbiriyle ve GMFCS ile uyumlu ölçeklerdir. *Türk Fiz Tıp Rehab Derg 2013;59:18-25.*

Anahtar Kelimeler: Serebral palsi, el fonksiyonu, kaba motor fonksiyon

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Introduction

Cerebral Palsy (CP) is a group of persistent disorder of motion and posture development which arises as a result of an unprogressive damage that occurs in developing fetal or infant brain. Cerebral Palsy's motor disorders are mostly accompanied by sensory and perceptual problems, cognitive disorders, communicative and behavioral problems, epilepsy and secondary musculoskeletal system problems (1). CP prevalence is determined to be 4.4 of 1000 live births in Turkey (2). These motor and musculoskeletal system disorders restrict the daily activities of children with CP.

Determining the functional level is crucial to evaluate the achievements, in the aftermath of the rehabilitation program (3,4). There are some measurements developed to evaluate the upper extremity functions of patients with CP. One of these measurements is hand Manual Ability Classification System (MACS) that evaluates CP patients' hand use ability in daily life when holding an object (5). The aim is to determine the hand performance, not the maximum capacity. It evaluates both hand functions together (6). Bimanual Fine Motor Function (BFMF) rather expresses the various functional limitations in using both hands. Both hands have motor skills at level I without any limitation and at level V both hands have just holding skill or worse (7).

Although Gross Motor Function Classification System (GMFCS) can evaluate the gross motor functions like independent walking or sitting of the patient, an additional classification is necessary to evaluate hand functions (5,8). Solely, it may provide sufficient information about the clinic of the patient (8); however, combining with a test which evaluates the hand functions may provide extensive information about the clinic of the patient. It also helps to determine the targets of rehabilitation and to plan the rehabilitation program according to the level of the patient (5,8-10).

The aim of this study is to evaluate the relation between CP severity and hand functions of children with CP.

Material and Methods

Subjects

This study has been carried out in Ankara Physical Medicine and Rehabilitation Training and Research Hospital CP Department between January 2008 and September 2009. In total, 87 (50 male, 37 female) children with CP between 4-15 years who underwent rehabilitation program were included in the study. The study has been approved by Hospital Local Ethic Board and the parents were informed about the methods to be performed. Patients were classified by Swedish Classification; spastic (hemiplegic, diplegic, quadriplegia), dyskinetic, ataxic, mixed (11).

Measures

GMFCS was used to determine the severity of CP, MACS and BFMF measurements were used to evaluate the hand functions. Each measurement was performed by individual observers for three days after the patients were admitted to the hospital.

GMFCS (Gross Motor Function Classification System): The GMFCS was developed by Palisano et al. (12) to objectively classify the motor disability of the children between ages of 1-12. GMFCS classifies the severity of CP in five levels. It classifies the patients in 4 age groups (under 2, between 2 to 4 years, between 4 to 6 years and between 6 to 12 years). Sitting underlines child's place changing and moving initiatives. The differences are based on the functional limitations, the need of holding devices which helps to move, (walker, walking stick or baton) or wheeled moving devices and as a less, to the quality of the motion.

1. Level I: Walks without restrictions, limitations in more advanced gross motor skills.

2. Level II: Walks without restrictions, limitations walking outdoors and in the community.

3. Level III: Walks with assistive mobility devices, limitations walking outdoors and in community.

4. Level IV: Self mobility with limitations, children are transported or use power mobility outdoors and in the community.

5. Level V: Self mobility is severely limited, even with use of assistive technology (13).

The researches have shown that GMFCS is one of the most reliable and valid classification systems especially for the children above the age of 2 (14-18). Palisano et al. (15) showed that GMFCS could be used to determine the severity of the disease.

MACS (Manual Ability Classification System): It is a classification to evaluate the hand functions. It was first designed in 2001 World Health Organization's International Classification of Function Disability and Health Meeting. (International Classification of Function, Disability and Health-ICF (19). Later on, MACS, capable of evaluating the handling skill has been developed. It was first designed to measure the hand functions between the ages of 8-12. Then reliability and validity was proved at the age of 4 and above (between health professionals ICC=97%) and between the families and professionals ICC=0.96 (between 95% of confidence). It evaluates (5) the children with CP's hand use ability when holding an object in daily activities. The aim is to determine the hand performance, not the maximum capacity. The both hand functions are evaluated together and it is examined in five levels.

1. Level I; Handles objects easily and successfully,

2. Level II: Handles most objects but with somewhat reduced quality and/or speed of achievement,

3. Level III: Handles objects with difficulty, needs help to prepare and/or modify activities,

4. Level IV: Handles a limited selection of easily managed objects in adapted situations,

5. Level V: Does not handle objects and has very limited ability to perform even simple actions (5).

BFMF (Bimanual Fine Motor Function): Beckung et al. (20) developed BFMF to evaluate each hand function separately and it has 5 levels.

1. Level I: One hand: manipulates without restrictions. The other hand: manipulates with restrictions or limitations in more advanced fine motor skills.

2. Level II:

a) One hand; manipulates without restrictions. The other hand, only ability to grasp or hold.

b) Both hands; limitations in more advanced fine motor skills

3. Level III:

a) One hand; manipulates without restrictions. The other hand: no functional ability.

b) One hand; limitations in more advanced fine motor skills. The other hand; only ability to grasp or worse.

4. Level IV:

a) Both hands; only ability to grasp.

b) One hand; only ability to hold. The other hand: only ability to hold or worse.

5. Level V Both hands; only ability to hold or worse (20).

Statistical Analysis

SPSS 15 package program was used for Statistical Analysis. $p<0.05$ accepted as significant. The relation between BFMF and MACS, GMFCS and MACS, GMFCS and BFMF were analyzed with Spearman correlation analysis. The patients were separated into two groups according to CP types; spastic (group 1, n=52) and ataxic, dyskinetic and mixed (group 2, n=35). In both groups the relations between BFMF and MACS, GMFCS and MACS, GMFCS and BFMF were evaluated with Spearman correlation analysis. Kappa values were calculated, as well. According to Altman, the Kappa value is to be interpreted as follows: <0.20 as poor agreement, 0.21 to 0.40 as fair, 0.41 to 0.60 as moderate, 0.61 to 0.80 as good, and >0.80 as very good agreement (9,21).

Results

In total, 87 patients included in the study, consisted of 37 female (42.5%), and 50 male (57.5%). The mean of age of the patients was 6.93±1.93 (4 to 13) years. According to CP type; 40 children (46.0%) were diplegic, 3 (3.4%)-hemiplegic, 9 (10.3%)-tetraplegic, 9 (10.3%)-ataxic, 5 (5.7%)-dyskinetic and 21 patients (24.1%) were mixed type CP. Distribution of the patients according to MACS, BFMF and GMFCS was shown in Table 1.

When the relation between BFMF and MACS was assessed by Spearman correlation analysis, strong positive correlation was determined (rs=0.947, p=0.001). Kappa value was calculated. The overall aggrement between the MACS and BFMF was decent (Kappa value=0.759) (Table 2).

When the relation between two measurements GMFCS and MACS was assessed by Spearman correlation analysis, very strong significant positive correlation was determined (rs=0.789, p=0.001). Kappa value was calculated. The overall agreement between the GMFCS and MACS was fair (kappa=0.363) (Table 3).

Similarly, there was a strong positive correlation between BFMF and GMFCS (rs=0.800, p=0.001). Kappa value was

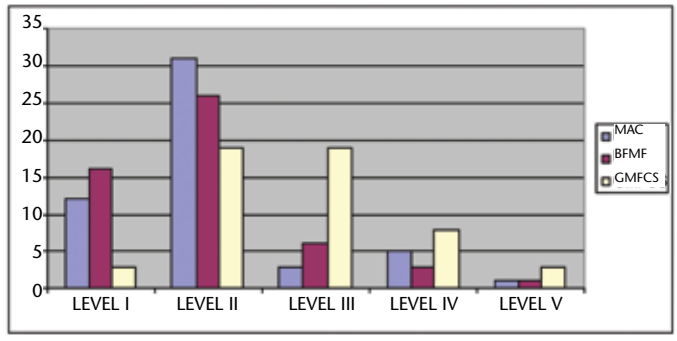

Figure 1. Distribution of the patients in group 1 according to the MACS, BFMF and GMFCS.

Table 1. Distribution of patients accoring to manual ability classification system (MACS), bimanual fine motor function (BFMF) and gross motor function classification system (GMFCS).

	Level I	Level II	Level III	Level IV	Level V
	(n, %)	(n, %)	(n, %)	(n, %)	(n, %)
MACS	12 (13.8%)	33 (37.9%)	13 (14.9%)	17 (19.5%)	12 (13.8%)
BFMF	16 (18.4%)	31 (35.6%)	13 (14.9%)	17 (19.5%)	10 (11.5%)
GMFCS	3 (3.4%)	20 (23.0%)	28 (32.2%)	14 (16.1%)	22 (25.3%)

MACS: Manual ability classification system, BFMF: Bimanual fine motor function GMFCS: Gross motor function classification system.

Table 2. Distribution of MACS and Bimanual fine motor function (BFMF) levels.

		BFMF					
		Level I (n, %)	Level II (n, %)	Level III (n, %)	Level IV (n, %)	Level V (n, %)	Total (n,%)
MACS	I	12 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	12 (100%)
	II	4 (12.1%)	28 (84.8%)	1 (3%)	0(0%)	0 (0%)	33 (100%)
	III	0 (0%)	3 (23.1%)	8 (61.5%)	2 (15.4%)	0 (0%)	13 (100%)
	IV	0 (0%)	0 (0%)	4 (23.5%)	13 (76.5%)	0 (0%)	17 (100%)
	V	0 (0%)	0 (0%)	0 (0%)	2 (16.7%)	10 (83.3%)	12 (100%)
	Total	16 (18.4%)	31 (35.6%)	13(14.9%)	17 (19.5%)	10 (11.5%)	87 (100%)

*kappa = 0.759, p<0.001.

MACS: Manual ability classification system, BFMF: Bimanual fine motor function.

calculated. The overall agreement between the BFMF and GMFCS was fair (Kappa=0.299). The distribution of BFMF and GMFCS levels among 87 children with CP shown on Table 4.

The patients were separated into two groups according to CP types; spastic (group1, n=52) and ataxic, dyskinetic and mixed (group 2, n=35). The distribution of patients in group 1 and group 2 according to MACS, BFMF and GMFCS were shown at Figure 1 and 2.

When the distribution of the patients' functional status was evaluated (Figure 1 and 2), a contradiction was observed. In spastic group, hand function is better than functional status, on the contrary in group 2, hand function is worse except group 5.

After the patients were separated into two groups, in both, the relation between BFMF and MACS, GMFCS and MACS, GMFCS and BFMF were analyzed with Spearman correlation analysis and Kappa values were calculated.

In group 1 - hemiplegic, diplegic, tetraplegic ones - for evaluation of hand functions, between MACS and BFMF, a strong positive corelation was determined (r=0,897, p<0,001); while evaluating the relations between hand functions and severity of CP, both relations between MACS and GMFCS and BFMF and GMFCS, were represented significantly important corelations (rs=0.488, p<0.001 and rs=0.476, p<0.001, respectively). Kappa value was calculated. The overall agreement between the MACS and BFMF was good (Kappa=0,782, p<0,001). Group 1 distribution of MACS and BFMF levels among 52 children with CP were shown on Table 5.

A moderate correlation between MACS and GMFCS was determined (rs=0.488, p<0.001). Kappa value was calculated the overall agreement between the MACS and GMFCS was poor (Kappa =0.185 p=0.004) (Table 6).

Similarly, a moderate correlation between BFMF and GMFCS was determined (rs=0.476, p<0.001). Kappa value was calculated. The overall agreement between the BFMF and GMFCS was poor (Kappa=0.151, p=0.024). Distribution of BFMF and GMFCS levels among 52 children in group 1 was shown in Table 7.

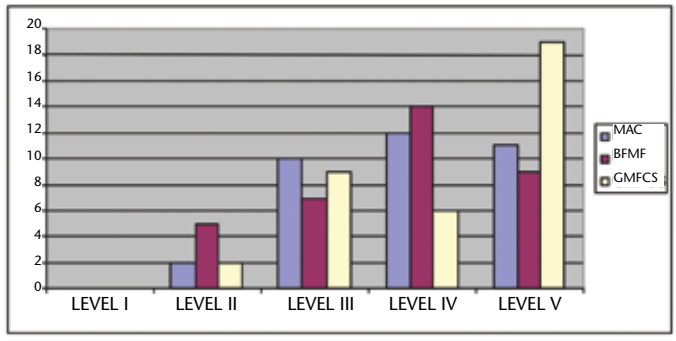

Figure 2. Distribution of the patients in group 2 according to the MACS, BFMF and GMFCS.

Table 3. Distribution of manual ability classification system (MACS) and bimanual fine motor function (GMFCS) levels.

		GMFCCS					
		Level I (n, %)	Level II (n, %)	Level III (n, %)	Level IV (n, %)	Level V (n, %)	Total (n, %)
MACS	I	1 (8.3%)	6 (50%)	5 (41.7%)	0 (0%)	0 (0%)	12 (100%)
	II	2 (6.1%)	14 (42.4%)	12 (36.4%)	5 (15.2%)	0 (0%)	33 (100%)
	III	0 (0%)	0 (0%)	9 (69.2%)	2 (15.4%)	2 (15.4%)	13 (100%)
	IV	0 (0%)	0 (0%)	2 (11.8%)	7 (41.2%)	8 (47.1%)	17 (100%)
	V	0 (0%)	0 (0%)	0 (0%)	0 (0%)	12 (100%)	12 (100%)
	Total	3 (3.4%)	20 (23%)	28 (32.2%)	14 (16.1%)	22 (25.3%)	87 (100%)

*kappa = 0.363, p<0.001.

MACS: Manual ability classification system, GMFCS: Gross motor function classification system.

Table 4. Distribution of bimanual fine motor function (BFMF) and gross motor function classification system (GMFCS) levels.

	GMFCCS						
	Level I (n, %)	Level II (n, %)	Level III (n, %)	Level IV (n, %)	Level V (n, %)	Total (n, %)	
BFMF	I	1 (6.3%)	8 (50%)	7 (43.8%)	0 (0%)	0 (0%)	16 (100%)
	II	2 (6.5%)	12 (38.7%)	12 (48.7%)	5 (16.1%)	0 (0%)	31 (100%)
	III	0 (0%)	0 (0%)	9 (69.2%)	3 (23.1%)	1 (7.7%)	13 (100%)
	IV	0 (0%)	0 (0%)	0 (0%)	6 (35.3%)	11 (64.7%)	17 (100%)
	V	0 (0%)	0 (0%)	0 (0%)	0 (0%)	10 (100%)	10 (100%)
	Total	3 (3.4%)	20 (23%)	28 (32.2%)	14 (16.1%)	22 (25.3%)	87 (100%)

*kappa = 0.299, p<0.001.

BFMF: Bimanual fine motor function GMFCS: Gross motor function classification system.

In the group 2 which includes ataxic, dyskinetic and mixed type a strong relation was determined between MACS and BFMF (rs=0.879, p<0.001). Kappa value was calculated. The overall agreement between the MACS and BFMF was good (Kappa= 0.641, p<0.0001) (Table 8).

Similarly, there was a strong relation between MACS and GMFCS (rs=0.722, p<0.001). Kappa value was calculated. The overall agreement between the MACS and GMFCS was moderate (Kappa value=0.466, p<0.001). Distribution of MACS and GMFCS levels among 35 children in group 2 was shown on Table 9.

There was a strong relation between BFMF and GMFCS (rs=0.852, p<0.001). Kappa value was calculated. The overall agreement between the BFMF and GMFCS was fair (Kappa value=0.379, p<0.001) (Table 10).

Table 5. Distribution of manual ability classification system (MACS) and bimanual fine motor function (BFMF) levels in group 1 patients.

		BFMF					
		Level I (n, %)	Level II (n, %)	Level III (n, %)	Level IV (n, %)	Level V (n, %)	Total (n, %)
MACS	I	12 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	12 (100%)
	II	4 (12.9%)	26 (83.9%)	1 (3.2%)	0 (0%)	0 (0%)	31 (100%)
	III	0 (0%)	0 (0%)	3 (100%)	0 (0%)	0 (0%)	3 (100%)
	IV	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	5 (100%)
	V	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	1 (100%)
	Total	16 (30,8)	26 (50%)	6 (11.5%)	3 (5.8%)	1 (1.9%)	52 (100%)

*kappa = 0.782, p<0.001.

MACS: Manual ability classification system, BFMF: Bimanual fine motor function.

Table 6. Distribution between levels of manual ability classification system (MACS) and gross motor function classification system (GMFCS) in group 1 patients.

		GMFCCS					
		Level I (n, %)	Level II (n, %)	Level III (n, %)	Level IV (n, %)	Level V (n, %)	Total (n, %)
MACS	I	1 (8.3%)	6 (50%)	5 (41.7%)	0 (0%)	0 (0%)	12 (100%)
	II	2 (6.5%)	13 (41.9%)	11 (35.5%)	5 (16.1%)	0 (0%)	31 (100%)
	III	0 (0%)	0 (0%)	3 (100%)	0 (0%)	0 (0%)	3 (100%)
	IV	0 (0%)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	5 (100%)
	V	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	1 (100%)
	Total	3 (5.8%)	19 (36.5%)	19 (36.5%)	8 (15.4%)	3 (5.8%)	52 (100%)

*kappa =0.185, p=0.004.

MACS: Manual ability classification system, GMFCS: Gross motor function classification system.

Table 7. Distribution of bimanual fine motor function (BFMF) and gross motor function classification system (GMFCS) levels in group 1 patients.

		GMFCCS					
		Level I (n, %)	Level II (n, %)	Level III (n, %)	Level IV (n, %)	Lavel V (n, %)	Total (n, %)
BFMF	I	1 (6.3%)	8 (50%)	7 (43.8%	0 (0%)	0 (0%)	16 (100%)
	II	2 (7.7%)	11 (42.3%)	8 (%30.8)	5 (19.2%)	0 (0%)	26 (100%)
	III	0 (0%)	0 (0%)	4 (%66,7)	1 (16.7%)	1 (16.7%)	6 (100%)
	IV	0 (0%)	0 (0%)	0 (0%)	2 (66.7%)	1 (33.3%)	3 (100%)
	V	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	1 (100%)
	Total	3 (5.8%)	19 (36.5%)	19 (36.5%)	8 (15.4%)	3 (5.8%)	52 (100%)

*kappa = 0.151, p=0.024.

BFMF: Bimanual fine motor function GMFCS: Gross motor function classification system.

Table 8. Distribution of manual ability classification system (MACS) and bimanual fine motor function (BFMF) levels in group 2 patients.

		BFMF					
		Level I (n, %)	Level II (n, %)	Level III (n, %)	Level IV (n, %)	Level V (n, %)	Total (n, %)
MACS	I	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (100%)
	II	0 (0%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)	2 (100%)
	III	0 (0%)	3 (30%)	5 (50%)	2 (20%)	0 (0%)	10 (100%)
	IV	0 (0%)	0 (0%)	2 (16.7%)	10 (83.3%)	0 (0%)	12 (100%)
	V	0 (0%)	0 (0%)	0 (0%)	2 (18.2%)	9 (81.8%)	11 (100%)
	Total	0 (0%)	5 (14.3%)	7 (20%)	14 (40%)	9 (25.7%)	35 (100%)

*kappa = 0.641, p<0.001.

MACS: Manual ability classification system, BFMF: Bimanual fine motor function.

Table 9. Distribution of manual ability classification system (MACS) and gross motor function classification system (GMFCS) levels in group 2 patients.

		GMFCCS					
		Level I (n, %)	Level II (n, %)	Level III (n, %)	Level IV (n, %)	Level V (n, %)	Total (n,%)
MACS	I	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (100%)
	II	0 (0%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)	2 (100%)
	III	0 (0%)	0 (0%)	6 (60%)	2 (20%)	2 (20%)	10 (100%)
	IV	0 (0%)	0 (0%)	2 (16.7%)	4 (%33.3)	6 (50%)	12 (100%)
	V	0 (0%)	0 (0%)	0 (0%)	0 (0%)	11(100%)	11 (100%)
	Total	0 (0%)	1 (2.9%)	9 (25.7%)	6 (17.1%)	19 (54.3%)	35 (100%)

*kappa = 0.466, p<0.001.

MACS: Manual ability classification system, GMFCS: Gross motor function classification system.

Table 10. Distribution of bimanual fine motor function (BFMF) and gross motor function classification system (GMFCS) levels in group 2 patients.

		GMFCCS					
		Level I (n, %)	Level II (n, %)	Level III (n, %)	Level IV (n, %)	Level V (n, %)	Total (n, %)
BFMF	I	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (100%)
	II	0 (0%)	1 (20%)	4 (80%)	0 (0%)	0 (0%)	5 (100%)
	III	0 (0%)	0 (0%)	5 (71.4%)	2 (28.6)	0 (0%)	7 (100%)
	IV	0 (0%)	0 (0%)	0 (0%)	4 (28.6%)	10 (71.4)	14 (100%)
	V	0 (0%)	0 (0%)	0 (0%)	0 (0%)	9 (100%)	9 (100%)
	Total	0 (0%)	1 (2,9%)	9 (25.7%)	6 (17.1%)	19 (54.3%)	35 (100%)

*kappa = 0.379, p<0.001.

BFMF: Bimanual fine motor function, GMFCS: Gross motor function classification system.

Table 11. Comparison of the parameters according to the groups.

Parameters	Group 1				Group 2			
	Correlation		Kappa statistic		Correlation		Kappa statistic	
	rs	p	Kappa	p	rs	p	Kappa	p
BFMF-MACS	0.897	<0.001	0.782	<0.001	0.879	<0.001	0.641	<0.001
MACS-GMFCS	0.488	<0.001	0.185	0.004	0.722	<0.001	0.466	<0.001
BFMF-GMFCS	0.476	<0.001	0.151	0.024	0.852	<0.001	0.379	<0.001

The comparison of the correlations and Kappa values between BFMF and MACS, MACS and GMFCS, BFMF and GMFCS in group 1 and 2 were shown on Table 11.

Discussion

According to the parameters of this study, it is concluded that MACS and BFMF which evaluate the hand functions of children with CP are compatible with each other. Moreover, it is also observed that the measurements are also compatible with the CP severity and when CP severity increases the hand skills are deteriorated. Meantime we have shown that the compatibility level can be changed according to CP type.

Carnahan et al. (8) mentions that BFMF rather determines the disability of the patient and MACS evaluates the activity, for this reason it is difficult to compare MACS and BFMF. However we have ascertained a positive strong correlation between MACS and BFMF (rs=0.947, p=0.001). Similarly the overall agreement between the MACS and BFMF was good (Kappa=0.759, p<0.001).

We have shown that hand skills are deteriorated with CP severity. We have also determined a strong correlation between MACS and GMFCS (rs=0.789, p=0.001), BFMF and GMFCS (rs=0.800, p=0.001). But the overall agreement between the MACS and GMFCS (Kappa=0.363, p<0.001) BFMF and GMFCS (Kappa=0.299, p<0.001) were fair. In our study, we also examined the overall agreement and found similar results with previous studies (3,8). Although we found a high correlation by the Spearman rank correlation test, a poor relation was found by Kappa statistics similar to those of the Gunel et al.'s (3) study. This may have occurred due to the characteristics of Kappa statistics that indicates the relation of the same scale in different researches. Hence, the correlation coefficient represents the agreement between two different classifications (21).

The aim of MACS is to evaluate the CP patients' ability of hand usage on daily life activities. Usually, this is compatible with the gross motor function of the patient. (22). In a recent study, Morris et al. (23) has shown the reliability of MACS. In the research on 168 patients which was made by Ellison et al. (5), the reliability and validity of MACS was short and strong correlation between MACS and GMFCS was found. Günel et al. (3) mentioned that there was a close relationship between MACS and GMFCS to compare the functional level. They determined high correlation between MACS and GMFCS, which is similar to our study (rs=0.735, p<0.01).

Previously, there were just two researches which compared BFMF and GMFCS. Beckung et al. and determined strong correlation between BFMF and GMFCS (13,20). We have also determined strong correlation between BFMF and GMFCS. Furthermore, we have determined a significant difference in terms of CP severity and hand skill tests between group 1 diplegic, hemiplegic, tetraplegic patients and group 2 dyskinetic, ataxic, mixed patients. We have shown that spastic children have better hand skills and gross motor functions.

When we compared group 1 and group 2 separately in terms of the relation between MACS and BFMF, MACS and GMFCS, BFMF and GMFCS, we have determined that the relation of MACS and GMFCS, BFMF and GMFCS are stronger in group 2. We may conclude that when the hand functions of group one is better, the gross motor functions are worse. Carnahan et al. (8) showed in their research that the correlation level between MACS and GMFCS changes in different types of CP

In conclusion, BFMF and MACS are compatible with each other and with GMFCS as well and these tests can be rapidly performed in clinic. However the compatibility level may change depending on the CP type.

Conflict of Interest
Authors reported no conflicts of interest.

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