Research Article

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Reliability of the Turkish adaptation of the Modified House Classification System in children with cerebral palsy

Meltem Baydar[1], Özlem El[2], Haluk Berk[3], Minuse Özlen Peker[2], Ebru Şahin[2], Can Koşay[3]

[1]Clinic of Physical Medicine and Rehabilitation, Medicana International Hospital, Samsun, Turkey
[2]Department of Physical Medicine and Rehabilitation, Dokuz Eylül University School of Medicine, İzmir, Turkey
[3]Department of Orthopaedics and Traumatology, Dokuz Eylül University School of Medicine, İzmir, Turkey

Abstract

Objective: The aim of this study was to investigate the validity and reliability of the Turkish version of the Modified House Classification System (MHCS) in children with cerebral palsy (CP).

Methods: Forty-five patients were evaluated by two physicians and the intra-rater reliability within a subgroup of 21 patients was assessed. Intra-rater and inter-rater reliability were also analyzed using intraclass correlation coefficient (ICC), and Spearman's rank-order correlation test was used to indicate an association between the Manual Ability Classification System (MACS) and the MHCS. Internal consistency was measured using Cronbach's alpha.

Results: Intra-rater and inter-rater reliability and internal consistency of the MHCS were found to be excellent with a Cronbach's alpha value of 0.89 and ICC value of 0.97 and 0.98 respectively. A significant correlation was found between the MACS and MHCS ($p<0.001$, $r= -0.805$).

Conclusion: The inter-rater and intra-rater reliability of Turkish version of the MHCS were found to be high regarding the assessment of Turkish children with CP.

Keywords: Cerebral palsy and reliability, Modified House Classification, Turkey

INTRODUCTION

Cerebral palsy (CP) is the name given to a group of permanent movement and posture development disorders that occur due to non-progressive damage to the brain of the infant or developing fetus (1). Manual skill and upper limb functionality are limited in children with CP. The type and severity of the hand function disorder (e.g. motor or sensory dysfunctions) largely depend on the location, severity, and time of occurrence of the brain injury. Therefore, in children with various types of CP (i.e., hemiplegia, diplegia, and tetraplegia), hand function disorders require classification (2). Classification should be performed to evaluate upper extremities, compare or distinguish the cases, assess the efficacy of treatment, and guide the treatment plan (3).

Currently, different classification systems for the hand functions of children with CP are available. The Manual Ability Classification System (MACS), which is one of these systems, was developed to evaluate the ability of the child to use daily objects (4). It classifies the use of the hands while handling objects during the daily activities of children with CP. It is a valid, reliable, understandable, and easily applied system, which provides a numeric score of the child's real performance level in daily life. The MACS has five levels (5). It was not developed to describe the optimal capacity or function of an individual's upper extremity, by comparing affected and unaffected functions, rather it reports the performance of upper extremity tasks regardless of how they are described in daily activities, and the cooperation of the two hands in bimanual activities (6). Its validity and reliability were proven in several studies and Turkish validity and reliability studies have been completed (4, 5, 7, 8).

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Corresponding Author: Meltem Baydar **E-mail:** meltembaydar@hotmail.com **Submitted:** 10 November 2018 **Accepted:** 14 March 2019

The original House Functional Classification System is a classification system developed by House et al. in 1981, which comprises nine global categories describing upper extremity functions (9). Due to the lack of details in describing these categories, by adding specific criteria to the existing classification system, which clarify the evaluation process, the Modified House Classification System (MHCS) was developed by Koman et al. in 2008 (Appendix 1) (10). The validity and reliability study of this system in children with CP was also performed by Koman et al. (10). This system is based on observing the patient's performance during increasingly complex functional tasks. The system comprises 32 items, which evaluate the basic activities in daily life, such as reaching, grasping, and manipulating objects (Appendix 1). It allows evaluation of the best upper extremity capacity.

The reliability and validity of an assessment tool is important in effectively measuring the outcomes of a specific upper extremity interventions. In the present study, we aimed to assess the reliability of the Turkish version of the MHCS in children with CP.

METHODS

The Dokuz Eylül University Ethics Committee approved the study protocol (2012/09-19, 08.03.2012). Written informed consent was obtained from each parent. The study was conducted in accordance with the principles of the Declaration of Helsinki.

A total of 45 patients aged between 4 and 18 years with CP without communicative impairment were included in the study. All patients were regularly assessed and managed in our multidisciplinary CP outpatient unit.

Patients were classified according to the Swedish classification system. In this system, spastic CP was categorized as hemiplegic, diplegic, and tetraplegic; other clinical subtypes were dyskinetic (dystonic, athetoid), ataxic and unclassified / mixed (11).

Louis Andrew Koman who developed the MHCS was contacted via e-mail and the necessary permission was granted to adapt the MHCS into Turkish. A committee translated the MHCS into Turkish after obtaining permission from Louis Andrew Koman. The MHCS was translated and adapted according to the guidelines in the literature (Appendix 2) (12). A native English speaker who was fluent in both English and Turkish translated the text back to English (Appendix 3). This is the recommended method for translation procedure by the authors who developed the original system. Both the Turkish text and the text that was translated back to English were evaluated by the researchers who developed the original form and, therefore, the latest form of the Turkish translation was established.

For the reliability study, patients with CP who were followed in the department of Physical Therapy and Rehabilitation Treatment and Orthopaedics were evaluated independently by the same two investigators and their scores in the original MHCS and 14 items (items 9,13-24, and 26 in original MHCS) used in the study of Geerdink et al. were identified (13). The first assessments of the patients with CP were recorded by two physicians to determine the inter-rater reliability. In addition, intra-rater reliability was assessed by the re-evaluation of 21 cases by a physician with a time interval of approximately 2 weeks. Age, sex, aetiology, CP type, classification according to the Gross Motor Function Classification System (GMFCS), and the stage of the affected hand according to the MACS of the cases were recorded. The Turkish version of the extended and revised version of GMFCS was used to determine the motor function levels and impairment degree (14). For each age group, the GMFCS has a five-level classification system for the severity of impairment.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences version 22 software package (SPSS, IBM Corp.; Armonk, NY, USA). Descriptive statistics were demonstrated as mean (±standard deviations) for continous variables and as percentage (%) for nominal variables. Internal consistency was measured using Chronbach's alpha; >0.70 indicating an acceptable value (15, 16). Intra-rater and inter-rater reliability studies were also analyzed using intraclass correlation coefficient (ICC) (17). According to the ICC results, positive values ranging from 0 to 0.2 indicate poor agreement, 0.2 to 0.4 indicate fair agreement, 0.4 to 0.6 indicate moderate agreement, 0.6 to 0.8 indicate good agreement, and 0.8 to 1 indicate very good agreement (18). The concurrent validity was assessed using Spearman's rank-order correlation test to indicate an association between the MACS and MHCS. A p value of <0.05 considered statistically significant.

RESULTS

A total of 45 patients (31 boys, 14 girls) were included in the study. The mean age of the patients was 8.0±3.5 (range, 4-18) years. According to the Swedish classification, 17 (37.8%) patients had spastic hemiplegia, 23 (51.1%) had spastic diplegia, three (6.7%) had spastic tetraplegia, and two (4.4%) patients had dyskinesia. Sixteen patients were classified as level I, nine

Table 1. Demographic data and clinical subtypes of the study population

	n	%
Female	14	24.4
Male	31	75.6
Spastic hemiplegic	17	37.8
Spastic diplegic	23	51.1
Spastic tetraplegic	3	6.7
Dyskinethic	2	4.4

Table 2. Distribution of GMFCS levels according to the cerebral palsy types

	Level I (n)	Level II (n)	Level III (n)	Level IV (n)	Level V (n)
MACS	5	22	7	9	2
GMFCS	16	9	10	8	2

MACS: Manual Ability Classification System; GMFCS: Gross Motor Function Classification System

Table 3. Interrater and intra-rater reliability of the MHC System

	Interrater intraclass correlation coefficient (ICC)	Intra-rater intraclass correlation coefficient (ICC)
Modified House Classification System (0-32)	0.98	0.97
MHCS with 14 items	0.97	0.97

MHC: Modified House Classification System

as level II, ten as level III, eight as level IV, and two patients as level V. The MACS levels of the patients were also evaluated. Five patients were classified as level I, 22 as level II, seven as level III, nine as level IV, and two patients as level V. The demographic characteristics of the patients are shown in Table 1 and Table 2.

Reliability

Our results indicated that the inter-rater and intra-rater reliability of Turkish version of the MHCS was very good. The inter-rater and intra-rater reliability of the MHCS and MHCS with 14 items are shown in Table 3. The Cronbach's alpha reliability coefficient was used to determine internal consistency of the MHCS in the current study (Cronbach's alpha value: 0.89).

Validity

The validity of the MHCS was assessed through the correlation between the MACS and MHCS.

We found a significant correlation between the MACS and MHCS ($p<0.001$, $r= -0.805$).

DISCUSSION

Upper extremity evaluation in CP is of utmost clinical importance. Evaluation of these children is essential to determine the treatment method, assess the effectiveness of treatment, and to establish long-term follow-up (19). As in many fields of healthcare, the International Classification of Functioning, Disability and Health (ICF), which was revised and published by the World Health Organization in 2001, has been adopted as an essential structural model in the assessment of patients with CP. It also provides a useful framework for the assessment of the effects of physical or structural deficits (disorders) on keeping up with the duties and responsibilities (attendance) at home, at school, and in society (20). Thus, assessment tools for optimal results, as defined by the ICF, should include the multi-dimensional nature of function and be able to measure its multiple directions (21).

In the clinic, the use of upper extremity classification systems has different purposes. There are several valid and reliable classification systems used in upper extremity evaluations in children with CP. They can rate the severity of dysfunction by observing how the person uses the upper extremity during activities. They can also document the position of the joint and classify the deformity (22).

In the present study, the Turkish version of the MHCS had high reliability based on inter-rater and intra-rater assessment in Turkish children with CP. In addition, there was a significant correlation between the MACS and MHCS.

In a previous study, MHCS was recommended as a reliable tool to classify upper limb function in children with CP. In a review evaluating the validity, reliability and clinical use of the 18 classification systems, it was stated that the MACS and MHCS were valid and reliable classification systems, which are psychometrically powerful and excellent clinical benefits. The use of MACS and MHCS in the classification of upper extremity function in patients with CP has been recommended (22).

Park et al. also reported a strong association between the MHCS and MACS in children with CP, and that the MACS and MHCS complemented each other in assessing upper extremity function in children with CP (23). Furthermore, Geerdink et al. developed and tested the MHCS item hierarchy and unidimensionality using Rasch analysis to evaluate upper extremity capacity in children with unilateral CP (13). In the aforementioned study, the content validity of the Rasch-decreased item set was evaluated. The authors suggested that the MHCS, which included 14 items, would be useful in the assessment of the functional capacity of the affected hand in children with unilateral CP. In our study, we evaluated the correlation between the MACS and MHCS with 14 items and found a strong correlation between the two systems. The MHCS with 14 items was found to have a high reliability based on inter-rater and intra-rater assessment in Turkish children with CP.

In conclusion, evaluation of the functional and skill levels of children with CP in daily activities is of utmost importance in focusing on the problem and follow-up in the identification of rehabilitation objectives, and designation of rehabilitation programs. The MHCS is based on observing the patient's performance during increasingly functional tasks, and evaluates reaching, grasping, and manipulating objects. Therefore, based on our study results, we suggest that the MHCS is a simple and reliable classification system in the evaluation of upper extremities of children with CP. However, further studies that evaluate the correlation between the

MHCS and different methods used in the evaluation of the functional capacity in different types of CP and in different age groups are required.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Dokuz Eylül University (2012/09-19, 08.03.2012).

Informed Consent: Written informed consent was obtained from patients' parents who participated in this study.

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Appendix 1.

Modified House Classification System

Hand dominance	Right	Left
Affected extremity	Right	Left
Original House Category	Additional descriptors	

0.Does not use: Does not use.

- ☐ Does not use arm to push up into anti-gravity postures/transitions (except symmetrical upper extremity extensor posturing)
- ☐ Upper extremity in flexion posture
- ☐ No active opening of hand with touch to back of hand/forearm or to command

1. Poor passive assist Uses as a stabilizing weight only.

- ☐ Attempts to push or hold up body for anti-gravity positions/transitions with upper extremity
- ☐ Some volitional shoulder, elbow, or hand movement to aid in dressing or to move towards an object in front or to side of patient.

(2)

2. Fair passive assist Can hold onto object placed in hand.

- ☐ Consistent volitional shoulder, elbow, or hand movement towards an object in front of or to side of patient
- ☐ Attempts to relax or open palm for observer to place an object in the hand, but may not be able to fully make an open, flat palm

(4)

3. Good passive assist Can hold object and stabilize it for use by other hand.

- ☐ Brings hand to mouth if other hand is blocked, but does not have to reach mouth with fingers (pronated forearm)
- ☐ Makes fist and uses arm to stabilize objects such as paper or toys on a surface while other hand manipulates
- ☐ Retains item long enough for other hand to attempt interaction/manipulation
- ☐ Attempts release, but other hand may assist by pulling object out of grasp

(8)

4. Poor active assist Can actively grasp object and hold it weakly.

- ☐ Has functional shoulder, elbow or hand movement towards an object in front of patient.
- ☐ Active opening of fingers, but may have adducted thumb on approach to and grasp of object
- ☐ Rakes and has gross grasp of small block (1·1), but has no pad-to-pad or tip-to-tip finger pre hension
- ☐ Has voluntary release, but may use surface to release object
- ☐ Use body to help stabilize object against resistance while other hand manipulates (e.g. removing lid from marker pen)

(13)

5. Fair Active assist — Can actively grasp object and stabilize it well.

- ☐ Has some supination to reach for a vertically oriented object
- ☐ Can rake and grasp small beans
- ☐ Can retain object against moderate resistance while other hand manipulates (e.g. removing lid from marker pen)
- ☐ Has voluntary release in space

(17)

6. Good active assist — Can actively grasp object and manipulate it as well.

- ☐ Able to grade grasp with lightly resistive media such as paper or clothing without crushing while other hand manipulates
- ☐ Can hold paper to cut out a circle with the other hand; affected hand able to turn paper for cutting
- ☐ Can perform pad-to-pad pinch to pick up Cheerios one at a time but may have adducted thumb
- ☐ Can point with an extended finger (at least partially isolated while other fingers are out of the way)
- ☐ Has some wrist extension during release in space

(22)

7. Spontaneous use, partial — Can perform bimanual activities easily and occasionally uses the hand spontaneously.

- ☐ Can bring item in hand to mouth with forearm supination
- ☐ Can perform simple rotation of an object, turning it over 1/2 revolution with thumb, index, and long fingers
- ☐ Able to pick up dry beans from a surface one at a time and hold in ulnar side of hand while picking up another with radial side of hand
- ☐ Thumb able to oppose somewhat to pick up small items in a tip-to-tip pinch
- ☐ Able to fasten and unfasten a button bimanually

(27)

8. Spontaneous use, complete — Uses hand completely independently of other hand.

- ☐ Able to pick up, stabilize, and translate coins in and out of the hand
- ☐ Able to perform complex rotation with an object; shows isolated finger movements.
- ☐ Tip-to-tip pinch.
- ☐ Fine graded movements present to put small pegs into a pegboard unilaterally.
- ☐ Can write or draw with a mature grasp

(32)

Totals — Class (highest level at which all qualifiers were attained)

Cumulative points

Appendix 2.

Modifiye House Sınıflandırma Sistemi

Dominant el: Sağ Sol

Etkilenen el: Sağ Sol

0.Kullanım yok

Kullanmıyor

- ☐ Yerçekimine karşı pozisyon alma ya da geçiş için kolları kullanamaz (simetrik üst ekstremite ekstansör konumlama dışında)
- ☐ Üst ekstremite fleksiyon konumunda
- ☐ El sırtı/ ön kola dokunmakla veya komutla elin aktif olarak açılamaması

1. Kötü pasif yardım

Yalnızca dengeleyici ağırlık olarak kullanır.

- ☐ Üst ekstremite ile yerçekimine karşı pozisyon alma ya da geçiş için vücudu yukarı itme veya kaldırma girişiminde bulunur.
- ☐ Hastanın önündeki ya da yanındaki bir nesneye uzanmak veya giyinmeye yardımcı olmak için bazı istemli omuz dirsek ve el hareketi.

(2)

2. Orta pasif yardım

Ele yerleştirilen cismi tutabilir.

- ☐ Hastanın önündeki veya yanındaki bir nesneye doğru tutarlı istemli omuz, dirsek ve el hareketi
- ☐ Gözlemcinin avuç içine bir nesneyi yerleştirmesi için avucu gevşetme veya açma girişiminde bulunur fakat avucu tam olarak düz açamayabilir.

(4)

3. İyi pasif yardım

Diğer elle kullanılmak üzere nesneyi tutabilir ve sabitleyebilir.

- ☐ Diğer el engellendiğinde elini ağzına getirir fakat parmaklarla ağzına ulaşamaz (ön kol pronasyonda).
- ☐ Diğer el işlevini yapabilmesi için kağıt veya oyuncak gibi nesneleri, yumruk yaparak ve kolunu kullanarak bir yüzey üzerinde sabitler.
- ☐ Diğer el ile etkileşime geçene kadar ya da işlevsel olana kadar yeterince uzun süre işlemi devam ettirir.
- ☐ Serbest bırakmaya çalışır fakat diğer el kavranmış nesneyi çekerek çıkarmaya yardım edebilir.

(8)

4. Kötü aktif yardım

Aktif olarak objeyi kavrayabilir ve zayıfça tutabilir.

- ☐ Hastanın önündeki bir nesneye doğru fonksiyonel omuz, dirsek ve el hareketine sahip
- ☐ Parmakları aktif olarak açar, fakat nesneye yaklaşım ve kavramada başparmak adduksiyonda olabilir.
- ☐ Arayıp ulaşır ve küçük bir bloğu (1x1) kabaca kavrar fakat parmak ucu ve yüzeyi ile kavrama yapamaz.
- ☐ İstemli olarak bırakabilir fakat nesneyi bırakmak için bir yüzeye ihtiyaç duyabilir.
- ☐ Diğer el işlev yaparken dirence karşı nesneyi sabitlemeye yardımcı olmak için gövdeyi kullanır (örn: işaretleyici kalemin kapağını çıkarma)

(13)

5. Orta aktif yardım — Nesneyi aktif olarak kavrayabilir ve iyi sabitleyebilir.

- ☐ Dik yerleştirilmiş bir nesneye ulaşmak için bir miktar supinasyona sahip
- ☐ Arayıp ulaşabilir ve küçük fasulyeleri kavrayabilir.
- ☐ Diğer el işlev yaparken orta derecede dirence karşı nesneyi tutabilir (örn: işaretleyici kalemin kapağını çıkarma)
- ☐ Boşlukta bırakmaya sahip

(17)

6. İyi aktif yardım — Objeyi aktif olarak kavrayabilir ve ayrıca iyi de işlev görebilir.

- ☐ Diğer el işlev yaparken kağıt veya kumaş gibi hafif dirençli maddeleri buruşturmadan dereceli olarak kavrayabilir.
- ☐ Diğer el kağıttan bir daire keserken etkilenmiş el kağıdı çevirebilir.
- ☐ Her seferinde bir mısır gevreğini parmak yüzeyi ile yakalar fakat başparmak adduksiyonda olabilir.
- ☐ Bir parmağı düz uzatarak işaret edebilir. Bu parmak diğerlerinden en azından kısmen ayrıdır.
- ☐ Boşlukta bırakırken bir miktar el bilek ekstansiyonuna sahip

(22)

7. Kısmi kendiliğinden kullanım — Kolayca iki elli aktiviteleri yapabilir ve ara sıra eli kendiliğinden kullanır.

- ☐ Ön kol supinasyonda elindeki nesneyi ağzına getirebilir.
- ☐ Bir cismi başparmak, işaret parmağı ve uzun parmaklarla yarım devrin üstünde basitçe döndürebilir.
- ☐ Yüzeyden her seferinde birer birer alarak kuru fasulye toplayabilir. Elin radyal tarafıyla toplarken elin unlar tarafında biriktirebilir.
- ☐ Küçük nesneleri parmak ucuyla toplamak için başparmak biraz oppozisyon yapabilir.
- ☐ İki elle bir düğmeyi ilikleyebilir veya açabilir.

(27)

8. Tam kendiliğinden kullanım — Diğer elden bağımsız tam olarak elini kullanır.

- ☐ Madeni paraları elinde tutabilir, sabitleyebilir, alıp bırakabilir.
- ☐ Bir nesneye karmaşık döndürme yapabilir, ayrı ayrı parmak hareketleri sergiler.
- ☐ Parmak ucu kavrama
- ☐ Tek tarafla delikli tahta içine tahta çivileri koymak için ince hareketlerin varlığı
- ☐ Yazabilir, gelişmiş tam bir kavramayla çizebilir.

(32)

Toplam — Sınıf (tüm niteleyicilerde kazanılmış en yüksek düzey)

Toplam puan

Appendix 3.

Modified House Classification System

Dominant hand: Right Left

Affected hand: Right Left

0.Kullanım yok

Cannot use hands

- ☐ Cannot use arms for opposing gravity and assuming or maintaining position (except for symmetrical upper extremity extension position).
- ☐ Upper extremity flexion position.
- ☐ The patient cannot actively extend hand upon touch or command of the back or front arm.

1. Poor passive aid

Uses as a stabilizing weight.

- ☐ Uses upper body extemities to attempt to push or lift body upright and assume position for antigravity position
- ☐ There are some voluntary shoulder, elbow and hand movements when reaching for an object placed in front or to help while dressing.

(2)

2. Fair passive aid

Can hold object placed in hand.

- ☐ There are consistent voluntary shoulder, elbow and hand movements directed at objects in front of or near the patient.
- ☐ Can attempt to relax or open hand when observer places an object in the palm but may be unable to open palm flat.

(4)

3. Good passive aid

Can hold and stabilize an object for use with the other hand.

- ☐ When the other hand is prevented from movement, can move hand to mouth but cannot reach mouth with fingers (in frontal arm pronation).
- ☐ In order to enable the other hand to function, can make a fist and use the arm to stabilize objects, such as toys or paper, on a surface.
- ☐ Can continue an action for a relatively long period of time to enable the other hand to interact and/or become functional.
- ☐ Tries to release the object but may use other hand to withdraw the object.

(8)

4. Poor active aid

Can actively grasp an object and hold it but weakly.

- ☐ The patient has functional shoulder, elbow and hand movements directed toward the object in front of him.
- ☐ Can actively open fingers but might have thumb adduction when approaching and grasping an object.
- ☐ Can use open hands to find and roughly grasp a small block (1x1) but cannot hold it with the fingertips or pads.
- ☐ Can voluntarily release an object but may need a surface to place it on.
- ☐ When functioning with one hand, uses the body to stabilize the object (for example to take the top off a marker pen).

(13)

5. Fair Active Aid — Can actively grasp an object and stabilize it well.

- ☐ Possesses some degree of supination to reach out for a vertically placed object.
- ☐ Can use open hand to find and grasp small beans.
- ☐ When one hand is busy completing the action, can withstand moderate level resistance and hold an object (for example, removing the top of a marker pen).
- ☐ Can release something in mid-air

(17)

6. Good active aid — Can actively grasp and manuplate an object.

- ☐ While the other hand manuplates, can gradedly pick up light-resistance items such as cloth and paper without crumpling them.
- ☐ When one hand is cutting out a circular shape, the affected hand can rotate the paper.
- ☐ Can always catch a corn flake with the finger pads but might have thumb adduction.
- ☐ Can point by extending one finger straight out. This finger is at least partially separated from the others which are out of the way.
- ☐ Possesses some hand- wrist extension ability when releasing objects into mid-air.

(22)

7. Partial spontaneous use — Can comfortably do activities using both hands and occasionally uses hand spontaneously.

- ☐ Can bring object to mouth while the front arm is in supination.
- ☐ Can simply perform over midrotation an object using the thumb, the index finger and longer fingers.
- ☐ Can pick up beans from a surface one by one. Can use the radial side of the hand to gather, and the ulnar side to hold them.
- ☐ Can use the thumb for opposition while gathering small objects with fingertips.
- ☐ Can button and unbutton buttons by using two hands.

(27)

8. Complete spontaneous use — Can use hand completely independent of the other.

- ☐ Can pick up, stabilize, and transfer coins in or out of hands.
- ☐ Can accomplish complex rotation of an object; exhibits individual movements for each finger.
- ☐ Can grasp with fingertips.
- ☐ Prescence of fine motor actions to enable the patient to place wooden pegs into pegboard.
- ☐ Can write, and draw with mature grasp

(32)

Total — Classification: (the highest level according to points received on all qualifiers).

Total points: