

ARTIGO DE REVISÃO

O “teste de destreza manual Minnesota adaptado” utilizado como avaliação do potencial de uso de membros superiores de pacientes hemiplégicos

The “Adapted Minnesota Manual Dexterity Test” as an assessment tool for the hemiplegic patients’ upper extremity function

Maria Inês Paes Lourenção¹, Gracinda Rodrigues Tsukimoto², Linamara Rizzo Battistela³

RESUMO

O estudo mostra a adaptação do teste de destreza manual Minnesota, no seu subteste “de colocação”, como um modo de avaliação da função do membro superior hemiplégico, desde os que apresentam movimentos totais com déficit na destreza, até os que apresentam movimento parcial ativo ou nenhuma capacidade de preensão. O quanto, de fato o membro superior hemiplégico pode ser utilizado pelo paciente durante a realização de atividades, é muitas vezes, difícil de se mensurar. Acreditamos que o uso deste teste seja uma forma de se medir essa possibilidade e também de se medir a modificação dessa condição durante o decorrer do tempo, permitindo que façamos comparações de medições e evoluções de função do membro superior. Estas medições são úteis como estímulo de constatação da melhora da função do membro superior pelo próprio paciente e também poderão ser úteis em abordagens científicas quando queremos quantificar a performance de um paciente durante um tratamento.

PALAVRAS-CHAVE

hemiplegia, reabilitação, membros superiores, função manual, destreza manual.

ABSTRACT

The study shows the adaptation of the “Minnesota Manual Dexterity Test” in its Placing subtest, as an assessment tool for the evaluation of the hemiplegic upper extremity function, from individuals who present total movements with dexterity deficit to those who present active partial movement or no pressing capacity. To what extent the hemiplegic upper extremity can be, in fact, used by the individual during the accomplishment of activities, is normally difficult to measure. We believe this test can be used as a tool for the assessment of this capacity and also to measure the changes in this condition with time. It also allows us to compare measurements and the evolution of the upper extremity function. These measurements are useful, as they stimulate patients by making them aware of the upper extremity function improvement as well as regarding its scientific approaches to quantify a patient’s performance during treatment.

KEYWORDS

hemiplegia, rehabilitation, upper extremities, hand function, manual dexterity.

¹ Mestre e doutoranda em ciências da saúde pela Faculdade de Medicina da USP – Divisão de Medicina de Reabilitação do Hospital das Clínicas da Faculdade de Medicina da USP

² Mestre em ciências pela Faculdade de Medicina da USP - Divisão de Medicina de Reabilitação do Hospital das Clínicas da Faculdade de Medicina da USP

³ Professora adjunta do Departamento de Medicina Legal, Ética Médica, Medicina Social e do Trabalho da Faculdade de Medicina da USP - Diretora da Divisão de Medicina de Reabilitação do Hospital das Clínicas da Faculdade de Medicina da USP

Endereço para correspondência
Maria Inês Paes Lourenção
Rua Diderot 43 Vila Mariana
São Paulo SP 04116-030
inesto@terra.com.br

Recebido em 02 de Outubro, aceito em 13 de Novembro de 2006.

INTRODUCTION

Around 3.000 B.C., manual work was much appreciated, especially the crafting of ceramics, jewelry-making and carpentry and its production was destined to luxury consumption. Around the XVIII century, the modern industry was born, a fruit of the industrial revolution and the development of capitalism. As the industry started to manufacture products at a quantity never attained by crafting or even by manufacturing work, a gradual decrease in the value of manual work ensued. Currently, with the acknowledgement of the importance of leisure as one of the effective means for humans to attain well-being and with leisure activities being quite often developed through crafting, the latter has started to be valued again. It is also necessary to emphasize the process of self-care, which is certainly the basis of self-esteem and is strongly associated to manual functionality.

Most of the manual activities that we commonly perform in our daily lives require the use of the hands. Some people spontaneously use one hand more than the other due to personal conditions of dominance. However, healthy hands, with no motor or sensibility deficits are commonly used bimanually in activities, and especially those that are strictly bimanual. The bimanual use is common in the activities of daily living (ADL), which are performed by all persons when they care for themselves, such as getting dressed, showering and eating. The use of both hands also occurs constantly when performing activities of practical living (APL) such as answering the phone, dialing a number, opening the fridge, cooking and using the computer and the mobile phone, among others.

The hand is the element of value regarding the functional independence and currently receives more attention and care within the rehabilitation process.

Hemiplegia is the term used to describe paralysis of one side of the body (body dimidium), whether it is caused by ischemic stroke (IS), hemorrhagic stroke (HS) or head trauma (HT). Hemiplegia represents one of the most frequent forms of adult impairment, modifying the individual's participation in social, professional and self-care activities. The patient often presents a partial paralysis, which is called hemiparesis; however, it is very common to use the term hemiplegia for the patients who presents paralysis as well as for those who presents paresis. Thus, hemiplegia is so designated even when partial movements can be observed in the affected hand and it usually transforms the affected hand into the auxiliary hand.

Several tests have been developed to measure the upper limb function when there is a movement deficit. Some of them are mentioned below:

The Upper Limb Functional Test for Hemiplegia/Paresis evaluates the patient's skill to use the affected arm in tasks with a purpose. This test supplies an objective documentation of functional improvement. The test comprehends tasks that go from those involving basic stabilization to the most difficult ones, which require fine manipulation and proximal stabilization. Examples of such are: hold a coin purse, stabilize a vase, wring a cloth, open and close a zipper, fold a sheet and change a light bulb above one's head¹.

The Fugl-Meyer Test² is based on the natural progression of

recovery after a stroke. Low Fugl-Meyer scores have been closely correlated with the presence of acute spasticity¹. Fugl-Meyer *et al.* developed a quantitative evaluation of the motor function after a stroke, using the methods by Brunnstrom³ and measuring parameters such as range of movement (ROM), pain, sensation and balance. The Fugl-Meyer scores correlate to the performance at the ADL^{4,1}.

The arm motor skill test is a functional assessment of the upper limbs. To cut meat, make a sandwich, open a jar and put on a T-shirt are some of the tasks included in this test. It has a high inter-observer and test-retest reliability^{5,1}.

The Motricity Index is a valid and reliable test of motor efficiency that can be carried out quickly. It assesses the movement of picking up a cube with the thumb and the forefinger, as well as elbow flexion, shoulder abduction, ankle dorsiflexion, knee extension and hip flexion^{6,1}.

The Evaluation of Motor and Process Skills⁷ is a standardized test that assesses the motor and process skills in instrumental activities of daily living. The test was created by occupational therapists. Although it is not destined to a specific diagnosis, it has been broadly used in patients who had a stroke. Occupational therapists can be certified after a 5-day training course in order to apply this test^{7,1}.

The "Minnesota Manual Dexterity Test" measures the gross motor skills of the tested subject. The test has several objectives, such as documentation of the degree of impairment and/or progress of the patient regarding prehension, specific training for a task skill or a task that requires manual dexterity and all the manual activities of interest in practical life. The material to be used for the test of manual dexterity can be reproduced and is easily applied^{8,9,10,11}.

Description of the Minnesota Manual Dexterity Test

The complete Minnesota manual dexterity test (CMDT) is used to measure the simple and fast eye-hand coordination such as the arm-hand dexterity of the individual. In general, the CMDT measures the individual's gross motor skill. The gross motor skill involves the movement of the large musculature and where movement precision is not as important for the success of the skill performance as it is for the fine motor skills¹¹. Many studies have been developed to classify motor skill. Each classification system is based on the general nature of the motor skill related to some specific aspect of the skills. Magill¹⁰ considers 3 systems on which the motor classification is based: the precision of the movement, the definition of the movement initial and final points and the environment stability. The CMDT incorporates all these three systems in its 5 batteries of tests: Placing, Turning, Displacing, One-handed turning and placing, and Two-handed turning and placing.

For the complete Minnesota manual dexterity test (CMDT) to be consistent and standardized, the following materials or items are necessary: Minnesota Manual Dexterity Test Model #32023A, Instruction manual, two test boards, 60 black and red plastic blocks and record forms for keeping the scores. The test board must be between 28 and 32 inches high, and it is necessary to have a chronometer or timer with a 2-minute and 30 second (150-second) interval.

The plastic blocks are 60 cylindrical pieces weighing 15.3 g each, with 38 mm of diameter and 18 mm of length with a black base and a red one and two wooden boards that measure 83 cm long by 23 cm wide and 4 mm high, with openings that allow the perfect fitting of all the pieces. The 60 pieces fit into the board in a symmetrical way, in columns of 4 and rows of 15 pieces. Instructions are supplied for the interpretation of the test total score, adding the total number of seconds required to complete an initially chosen number of administered trials, 2, 3 or 4. The time that the test subject takes to perform the first trial is not considered in the test total score, as it is used for the person to get familiar with the material and the procedure. This trial is called the "practice" trial.

To start the test, the two boards are placed in alignment (one above the other) on a table 73 to 83 cm high, in front of test subject, 26 cm distant from the table border with the 60 blocks placed into the 60 openings of the board that is above the lower one. The lower board must be approximately 2.6 cm from the table border, close to the person being tested.

Subsequently, the test subject must be told that he or she will start on the right side, taking the lower piece from the upper board and placing it into the upper opening of the right column of the lower board, and then take the next piece and place it into the second opening, and then take the third piece and place it into the third opening, and do the same with the fourth piece, placing it into the lower opening of the right column of the board, when that sequence will be finished; the person must then continue, by repeating the previous test sequence in the second column and then the third and fourth columns and thus, sequentially, until he or she has completed the whole board. Therefore, the test subject must be warned that the first trial was a "practice trial", a type of training for the test, in order to understand it completely.

The word "ready" must be used so that the test subject is aware and can position the hand on the first piece to be fitted. The word "now" must be used to start the placing of the pieces and start the chronometer. The examiner must act accurately, as the test is measured in seconds and any indecision can affect the result. When the test subject places the last block of each trial, the chronometer is stopped and the time spent during the trial is recorded. The examiner must encourage the test subject verbally, in-between trials, so that he or she will feel stimulated to perform the test as fast as possible.

After the initial practice test and three or four consecutive trials, the times of the least three or four trials are added, thereby yielding the results of the Minnesota Placing Test.

In our study, we chose to adapt only the Minnesota Placing subtest, as our aim was focused on the unimanual function.

Adaptations of the Minnesota Manual Dexterity Test

1) The patient chooses whether to stand or sit down, whichever he or she considers more comfortable and better for his or her performance. The "practice trial" can be used for this experimentation. Afterward, when the trial results are being recorded for the general test result, this choice can no longer be modified.

2) The red-sided pieces are always placed side-up when any

trial is initiated.

3) The patient is allowed to perform prehension in any way he or she is able to and it is also allowed to displace the pieces by pushing them across the board, without using prehension.

4) It is allowed for patients with very low prehension skill as well as slow prehension to be tested. A 10-minute wait (600 sec) has been determined for each trial, and the number of pieces placed by the test subject is counted. A maximum waiting time has been determined, so that the total test does not exceed 40 minutes, the sum of four 10-minute trials.

5) In total, 4 trials are performed and the first "practice trial" is not computed for the test final result.

6) The final test result is established by an index, calculated based on the number of fitted pieces divided by the total of minutes spent to complete the performed trials.

DISCUSSION

We believe that, when we give the patient a choice between standing up or sitting down during the test performance, the final result will be closer to the way the patient would normally act if he or she used the tested upper limb when developing a routine activity.

When the red-sided pieces are placed side-up at the beginning of the test, we guarantee a contrast in the visualization of the pieces, as the board is black. Thus, it becomes easier to see the blocks and allows better visual discrimination of the pieces to be displaced by the patient.

When the patient is allowed to perform the piece prehension in any way he or she is able to and also to displace and place them by pushing them, without performing prehension, we are encouraging the patient to use the affected upper limb in daily routine activities, with the consequent inclusion of the upper limb into the body scheme. Our experience has shown that some patients are surprised with their skill of displacing the pieces and feel stimulated to perform this skill in everyday activities after this perception.

Below are some photographs showing different ways of performing displacement used by patients to accomplish the placing of the pieces into the Minnesota Manual Dexterity Test board. There are also some examples of the use of the hand in routine activities without the use of prehension.

When an index is specified, calculated by the number of fitted pieces divided by the total of minutes spent to complete the performed trials, we allow patients with very limited skill of piece sliding to be tested. This situation is very common in patients with hemiplegia and benefits those who have some movement in the upper limbs, although they do not perform prehension.

Although the test indicated that 4 or 5 trials could be made in all, with the first "practice trial" not being computed at the end of the test, there were no differences regarding the final result in the study carried out with hemiplegic patients when three or four test trials were used¹².

When a 10-minute wait (600 seconds) was specified for each

trial, and when the number of fitted pieces per patient was counted, we guaranteed that the maximum waiting time did not exceed 40 minutes, the sum of four 10-minute trials, preventing the possibility of fatigue and anxiety for the patients.

We know that it is very important for the hemiplegic patient to use the affected upper limb, even if it has little or no prehension; this is due to the fact that, in the absence of use, the patient is at risk of increasing spasticity, having a deformity or worsening the limb positioning pattern. An inadequate positioning might cause postural deviations during the performance of activities. These deficits can generate long-term problems and, therefore, it is mandatory that the hemiplegic patient without prehension in the affected upper limb be advised to frequently use the crossed hands to develop some ADL

and APL, for instance, and that the hemiplegic with some prehension be encouraged to use it constantly as an auxiliary hand, as this will send information on positioning and the use of the affected limb to the central nervous system, allowing neuroplasticity to occur. We believe that the "Minnesota Manual Dexterity Test" in its Placing sub-test, with the addition of some modifications created by our group, allows the measurement of the potential of use of the hand affected by hemiplegia.



Figura 1
Fitting of pieces performed with the ulnar border of the hand.



Figura 3
Fitting of pieces performed with the ulnar region of the hand.



Figura 2
Sliding of pieces performed with the dorsum of the fingers and closed hand.



Figura 4
Fitting of pieces performed with prehension between fingers II and III.



Figura 5
Opening the door function with hand fitted on the door handle.



Figura 7
Light switch handling with closed hand.



Figura 6
Opening the door function with closed hand.

CONCLUSION

The study shows the adaptation of the "Minnesota Manual Dexterity Test" in its Placing sub-test, as an assessment tool of the hemiplegic upper limb function, from those patients who present total movement with dexterity deficit to those who present partial active movement or no prehension skill. The test material is easily reproduced and applied. The test consists in the fitting of small cylindrical blocks into the corresponding holes in the base in a standardized and sequential way. The time spent by the tested person to complete this sequence is measured in seconds by the examiner by a chronometer.

Exactly how much the hemiplegic limb can be really used by the patient during the performance of activities is many times very difficult to measure. We believe the use of the "Minnesota Manual Dexterity Test" in its Placing sub-test, is a means to measure this possibility and also to measure the alterations in this condition throughout time, allowing comparisons of measurements and evolution of the upper limb function. These measurements are useful as stimulation by showing the patient the improvement in the upper limb function and can also be useful in scientific approaches when we want to quantify a patient's performance during treatment.

REFERENCES

1. Wilson DJ, Baker LL, Craddock JA. *Functional test for the hemiplegic/paretic upper extremity*. In: Downey, Calif. Controle motor. Los Amigos Research and Education Institute e Preston, L.A.; 1984. p. 379-404.
2. Katz, R.T. et al. Objective quantification of spastic hypertonia: correlation with clinical findings. *Arch Phys Med Rehabil*. 1992; 73(4): 339-347.
3. Brunnstrom, S.. *Moviment therapy in hemiplegia*. New York: Harper&Row, 1970.
4. Duncan, P.W. and Badke, M.B.. Measurement of motor performance and functional abilities following stroke. In: Duncan PW, Badke MB, editors. *Stroke rehabilitation: the recovery of motor control*. Chicago: 1987, Year Book.
5. Kopp, B. et al: The Arm Motor Ability Test : validity, and sensitivity to change of an instrument for assessing disabilities in activities of daily living. *Arch Phys Med Rehabil*. 1997; 78(6):615-620.
6. Colin, C and Wade, D. Assessing motor impairment after stroke: a pilot reliability study. *J Neurol Neurosurg Psychiatry*. 1990; 53(7): 576-579.
7. Bernspang, B and Fischer, A.G.. Differences between persons with right or left CVA on the Assessment of Motor and Process Skills. *Arch Phys Méd Rehabil*. 1995; 76:1114.

8. American Guidance Service. Minnesota Rate of Manipulation Test: Examiner's Manual. 1969. Circle Pines, Minnesota.
9. Jurgensen, C.E.. Extension of the Minnesota Rate of Manipulation Test. Journal of Applied Psychology. 1943; 27: 164-169.
10. Magill, R.A.. Motor Learning Concepts and Applications. Iowa: William C. Brown Publishers. 1989.
11. Roberts, J.R.. Pennsylvania Bi-Manual Worksample: Examiner's Manual. Circle Pines, Minnesota: guia do serviço americano. 1945.
12. Lourenção, M.I.P.; Battistella, L.R.; Martins, L.C.; Litvoc, J. Analysis of results of functional electrical stimulation on hemiplegic patients' upper extremities using the Minnesota manual dexterity test. Int J Rehabil Res. 2005; 28(1):25-31.