

MULTIMODAL EVALUATION OF THE EFFECTS OF PHYSIOTHERAPY ON STROKE PATIENTS WITH UPPERLIMB INVOLVEMENT

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The aim of this paper was to compile an easy testing battery, sensitive enough to register changes in the motor task performance of the paretic hand and disabled upper limb of patients who have had a brain stroke and are in the chronic stage.

We selected tests commonly used in rehabilitation to scan the characteristics and dynamics of test value changes after 10 kinesiotherapy lessons.

Most of our outcome had the same trend of slight improvement, but did not reach statistical significance because of the size of the group.

Only our pilot outcome is presented in this paper. We are going to continue this study.

Keywords: A self rating depression scale, dynamometer, nine hole peg test, tapping test, target test.

INTRODUCTION

Ischemic stroke is one of the most frequent neurological diseases. Thanks to modern medicine, we are able to use better treatment in the acute phase of stroke, to decrease mortality and lengthen life. Chronic stroke patients typically suffer from residual neurological deficit of varying severity and often do not continue therapy in an outpatient setting. There are marked differences in treatment responses in stroke patients because of the type and degree of neurological disease, polymorbidity, psychological changes and restriction of activities of daily living.

In order to evaluate the effectiveness of physical therapy, it is necessary to test patients at the beginning and at the end of therapy.

In our study, we tested chronic stroke patients' fine motor skills of the hand. We included tests commonly used in rehabilitation and additionally compared clinical measurements of two patients with differential motor cortical response to emotional voice auditory stimulation during a functional MRI examination.

OBJECTIVE

The aim of this paper was to compile a simple testing battery, sensitive enough to register changes in motor task performance of the paretic hand and the disabled upper limb in patients who have had a cerebrovascular stroke and are in the chronic stage of recovery.

METHODS

Questionnaires and tests

- 1) Mini Mental State Examination (MMSE) (Vaňásková, 2004; Anonymous, 2006) – is a widely used method for assessing cognitive mental status. The evaluation – a score of 30–25 points is standard, whereas a score of 0–15 points indicates a serious cognitive disorder.
- 2) The modified Ashworth scale of muscle spasticity (Bohannon & Smith, 1987; Opavský, 2003) – spasticity examination. Evaluation extremes – 0 – without increasing of muscular tonus/4(5) – affected areas of body are rigid in flexion or extension.
- 3) Functional Independence Measure (FIM) (Vaňásková, 2004) – this is useful for scoring locomotion abilities, activities of daily living and cognitive status. In evaluation, the score range is 18–126 points (motor task 13–91 points, mental status 5–35 points). A minimum score means full dependence, whereas a maximum score indicates independence (self sufficiency).
- 4) The Zung self rating depression scale (Zung, 1965) – a form filled in by the patient. Evaluation extremes – less than 50 points – without depression, 70 points and more – serious depression.
- 5) Hand functional test (Šibalová, Hlinecká, & Kačírková, 1995; Mikulecká, 2004) – each patient performs the following finger movements and grips – pinch, hooklet, roof, fist, thumb opposition,

cylinder grip, sphere grip and the like. The evaluation – 0 point – impossible, 1 point – incorrect, 2 points – well done. The maximum score is 16 points.

- 6) The dynamometer test – handgrip force is measured by a dynamometer (NordCoast Company) in kilograms. The measurement is performed three times and the results averaged.
- 7) Nine hole peg test – a test of fine motor task performance. The evaluation is made following recommendations of the manufacturer Roylan, Smith & Nephew. The outcome is measured in seconds. The maximum timeout is 7 minutes (420 seconds).
- 8) The tapping test – frequency of the index finger's movement (Vaverka & Hanuš, 2000) – we tested it with the device developed at the department of biomechanics and cybernetics at the Faculty of Physical Culture, Palacký University in Olomouc.
- 9) The target test – we tested coordination and the visuospatial skill of the hand (see below).
- 10) The functional MRI examination (fMRI) – performed at the department of radiology of the Faculty Hospital, at the Medical Faculty, Palacký University in Olomouc.

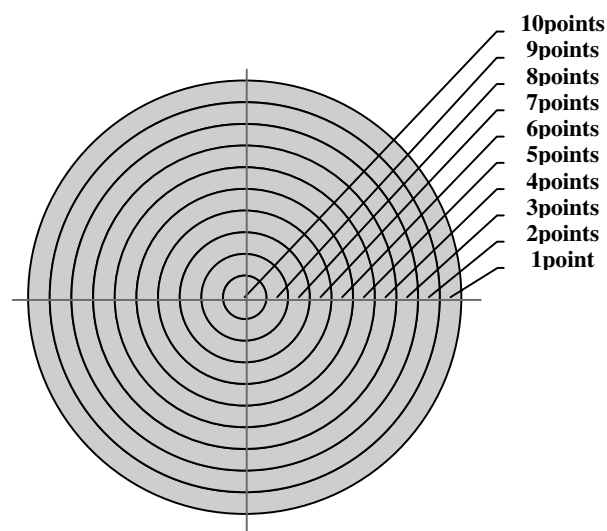
Measurement

Each patient passed an entry investigation, composed of all the described tests and questionnaires. After that, each patient had 10 kinesiotherapeutic lessons (twice a week) and at the end of the therapy process, he/she repeated the testing except for the fMRI investigation.

- The tapping test is done using a special device. The patient performs index finger tapping three times (with breaks) with both hands. One phase of the test takes 15 seconds. The results are processed by the computer. For evaluation we use the average value of three trials with each hand.
- The target test is an original method for the evaluation of the coordination and visuospatial orientation of the arm.

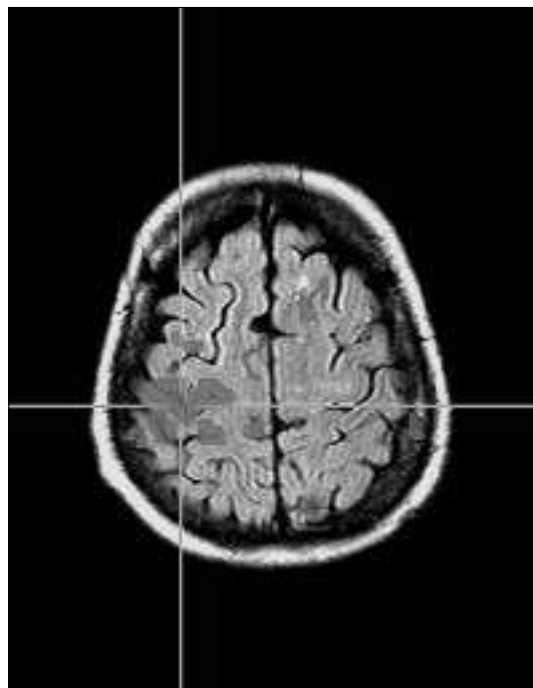
The patient sits in front of a vertical magnetic board within reach of his/her hand. His trunk is fixed to the backrest of the chair to avoid compensatory movements of the trunk. There is a target affixed to the board, which is divided into four equal quadrants (Fig. 1). The patient's task is to put a magnetic dart into the centre of the target. He/she uses his/her right hand and left hand three times each. The sum of points achieved in all trials is recorded and then divided by the number of "hit" quadrants. If the patient hits the same part of the target every time, the total is divided by one, if he hits two different parts, the total is divided by two, etc.

Fig. 1
The target



- The functional MRI examination (fMRI) is performed with Ing. MUDr. P. Hlušík, Ph.D.¹ We present the different findings as an example of fMRI results here, regarding emotive and indifferent voice auditory stimulation on a functional MRI examination during movements of the paretic hand in three patients – Fig. 2, 3, and 4.

Fig. 2



¹ At the department of radiology of the Faculty Hospital, the Medical Faculty, Palacký University in Olomouc. This cooperative effort has been supported by Grant IGA MZ ČR Nr. 8367-3.

Fig. 3

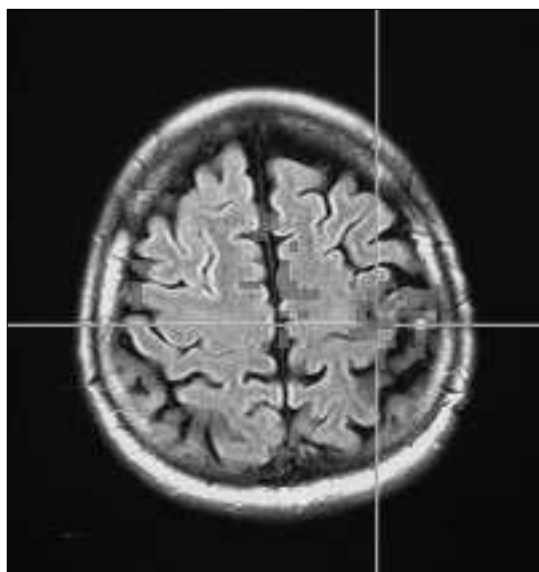
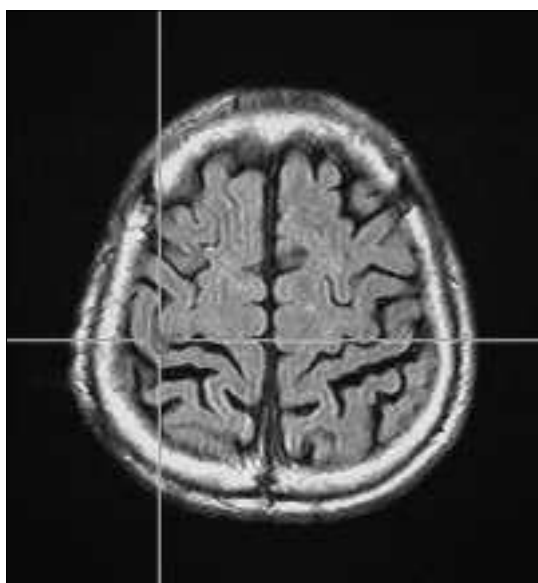


Fig. 4



RESULTS AND DISCUSSION

The group included 7 patients (2 women, 5 men), aged 68 (± 11 years), in the chronic phase of the illness, 2–3 years after having had an ischemic brain stroke which was located in the middle cerebral artery territory.

1) MMSE results – all of the patients reached the range score of 30–24 points. This indicates a normal cognitive mental status, which was also the condition for being included in the group.

2) We tested the elbow and wrist with the modified Ashworth scale for the examination of muscle spastic-

ity. The highest value reached in this test was 3. For the individual scores of muscle spasticity see TABLE 1.

TABLE 1

Examination of muscle spasticity with the modified Ashworth scale

Pa- tient	Elbow				Wrist			
	Non paretic hand		Paretic hand		Non paretic hand		Paretic hand	
	before	after	before	after	before	after	before	after
1	0	0	1	1	0	0	3	3
2	0	0	0	0	0	0	0	0
3	0	0	1	0	0	0	0	0
4	0	0	1	1	0	0	1	1
5	0	0	1	1	0	0	0	0
6	0	0	0	0	0	0	1	0
7	0	0	2	1	0	0	3	2

3) FIM results – patients achieved the average value of 85 points in each motor task before and after therapy, and 33 points in mental status. In the overall assessment, they got 117 points from a maximum of 126 possible points. They all were in the zone of self sufficiency. During the 5 weeks, there was no considerable change in the average value.

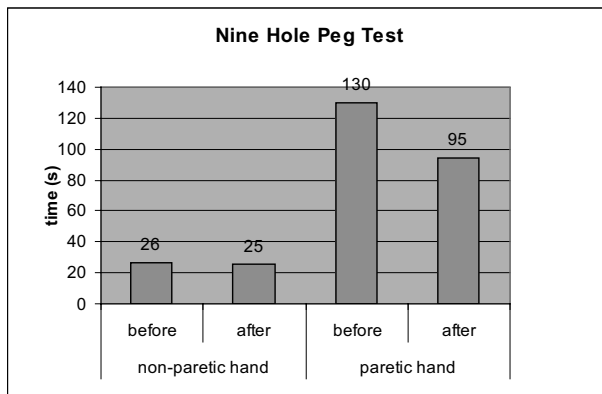
4) The Zung self rating depression scale – before the therapy, 5 patients scored within the range of moderate depression and only 2 patients were without depression. After the therapy, 4 patients were without depression and this happened without using antidepressant drugs. Another 3 patients stayed in the range of moderate depression, but their scores shifted towards the normal range.

5) Hand functional test – we used the percentage from the overall assessment of the healthy hand (referential) for estimation of the condition of the paretic hand. The average score of the paretic hand rose after the therapy from 48% (7.6 points) to 54% (8.6 points) for a maximum of 16 possible points.

6) The dynamometer test – in the representation of the percentage of the maximal force relative to the healthy hand, the average value before the therapy was 52% (15.3 kilograms) and 56% after the therapy (16.5 kilograms).

7) Nine hole peg test – the average results are depicted in Fig. 5. You can see the improvement in this test, but this change did not reach statistical significance due to the small size of the group.

Fig. 5
Nine hole peg test



8) The tapping test – the frequency of the index finger movement – results (the average value from three trials for each person) are showed in TABLE 2. Zero means that the patient could not manage the task. In TABLE 2 we also show the change of duration differences (in seconds) in the nine hole peg test.

TABLE 2
Tapping test

Patient	Number of beats		Frequency (Hz)		9 hole peg test duration change (s)
	before	after	before	after	
1	0	0	0	0	55
4	0	19	0	1.240	65
5	48	60	3.220	4.022	5
6	53	54	3.530	3.580	0
7	10	12	0.644	0.780	120

TABLE 3
The target test

Patient	Non paretic hand				Paretic hand			
	Before		After		Before		After	
	Sum of points	Score	Sum of points	Score	Sum of points	Score	Sum of points	Score
1	30	30	30	30	30	30	28.5	28.5
2	30	30	29	29	29.5	29.5	30	30
3	29.5	29.5	30	30	30	30	30	30
4	30	30	30	30	24	12	28	14
5	30	30	30	30	30	30	30	30
6	28.5	28.5	28.5	28.5	29.5	29.5	29	14.5
7	30	30	30	30	0	0	4.5	2.25

9) The target test: the results are showed in TABLE 3.
10) The functional MRI examination (fMRI) – we show only 2 findings here for illustration – person A – a right hander with ischemic brain stroke, Fig. 6, 7, person B – a left hander with ischemic brain stroke, Fig. 8, 9. Statistically significant brain activation during movement of the paretic hand is displayed (in red) against a background morphological MR image of the same slice (grey coloured scale). Movement was guided by auditory instructions given with alternatively an emotional (E) tone of voice alternating with an indifferent (I) tone of voice.

Fig. 6
Person A – E

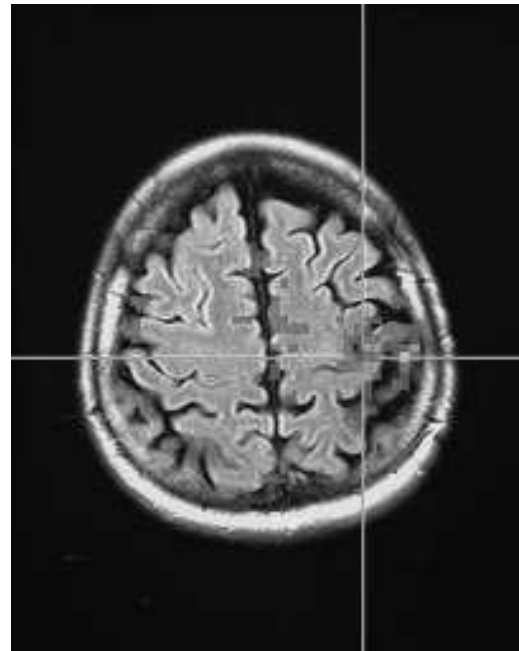


Fig. 7
Person A – I

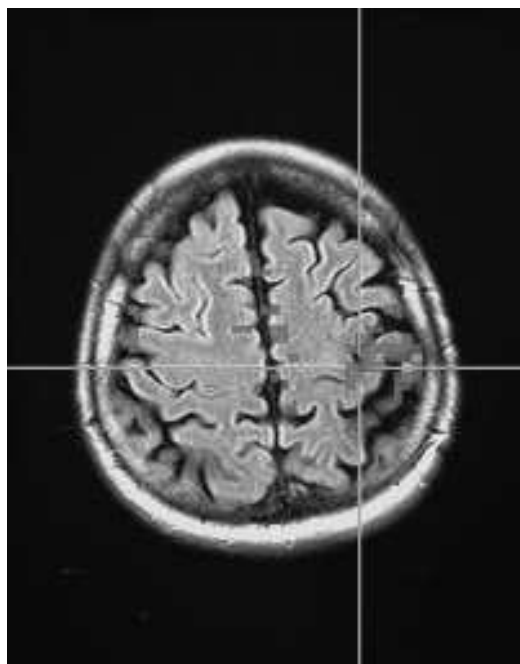
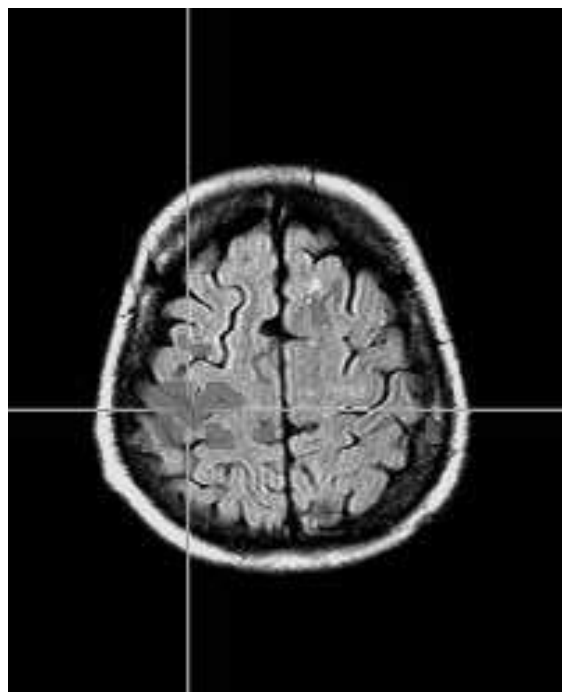


Fig. 8
Person B – E



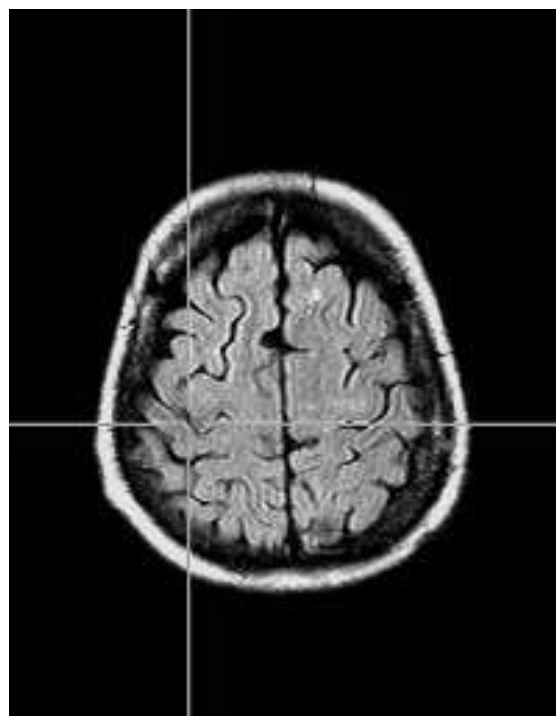
In TABLE 4, we present the changes of differences in the other tests for the persons A and B before and after the therapy. The fMRI findings and the clinical measurement revealed no relationship.

TABLE 4

The changes of differences before and after the therapy by persons A and B

	A	B
FIM	0	0
Hand functional test	0	1
The dynamometer test changes (kgs)	-1.33	-0.34
Nine hole peg test duration change (s)	55	120
Tapping test (number of beats/frequency Hz)	0 / 0	2 / 0.136
The target test	0	2.25

Fig. 9
Person B – I



CONCLUSION

The most significant change after the therapy was registered in the shortening of the time required in order to perform the nine hole peg test. The smallest change occurred in the FIM. The score on the Zung self rating depression scale decreased in all patients, two of them shifted from the range of depression to the normal range (without depression). Changes in the other tests had the same trend of slight improvement, but they did not reach statistical significance. In the dynamometer test, there was paradoxical moderate worsening in some patients.

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**MULTIMODÁLNÍ HODNOCENÍ
FYZIOTERAPEUTICKÉHO ÚČINKU
U PACIENTŮ S POSTIŽENÍM HORNÍ
KONČETINY PO CÉVNÍ MOZKOVÉ PŘÍHODĚ
(Souhrn anglického textu)**

Úkolem této práce bylo sestavení jednoduché testové baterie, která by citlivě registrovala změny motoriky parietické ruky a postižené horní končetiny u pacientů po cévní mozkové příhodě v chronickém stádiu.

Vycházeli jsme z běžně dostupných testů (Nine hole peg test, dynamometrie apod.), které jsou pro tyto účely v praxi nejvíce využívány, a sledovali jsme charakter a dynamiku jejich změn po 10 rehabilitačních procedurách.

Většina výsledků u vybraných testů měla obdobnou tendenci k mírnému zlepšení, ale vzhledem k rozsahu souboru nedosáhly tyto změny hladiny statistické významnosti. Prezentované nálezy předkládáme pouze jako výsledky pilotní studie. Studie bude pokračovat a soubor bude dále rozšiřován.

Klíčová slova: Zungova sebeposuzovací stupnice deprese, dynamometrie, nine hole peg test, tapping test, test terče.

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