



The impact of movement rehabilitation on functional recovery to everyday activities in stroke patients – preliminary report

Received 5-07-2015 Gabriela Walla¹, Ewa Żmudzka-Wilczek^{2,3}, Katarzyna Mazur¹,
Accepted 9-11-2015 Paweł Ryngier^{4,5}, Agnieszka Nawrat-Szołtysik⁶
Published 30-11-2015

¹Chair of Kinesitherapy and Special Methods in Physiotherapy, the Jerzy Kukuczka Academy of Physical Education, Mikołowska 72B, 40-065 Katowice. Head: Associate Professor Edward Saulicz MSc PhD

²Chair of Nervous and Locomotor System Physiotherapy, the Jerzy Kukuczka Academy of Physical Education, Mikołowska 72B, 40-065 Katowice.

³Institute of Medical Sciences, Katowice School of Economics, ul. Harcerzy Września 3, 40-659 Katowice.

⁴Chair of Fundamentals of Physiotherapy, the Jerzy Kukuczka Academy of Physical Education, Mikołowska 72B, 40-065 Katowice.

⁵University of Dąbrowa Górnicza, Department of Pedagogy, Institute of Physiotherapy

⁶Chair of Health Promotion and Research Methodology, the Jerzy Kukuczka Academy of Physical Education, Mikołowska 72B, 40-065 Katowice.

Abstract	
Background:	The main objective of this study was to demonstrate the beneficial effects of rehabilitation on self-sufficiency and recovery to everyday activities in patients after stroke.
Material/Methods:	The study group comprised 20 patients (11 women and 9 men), who were randomly allocated into two groups of 10 participants each. The first was the control group whose members underwent a 3-week rehabilitation program used in the Neurological Department of the District Hospital in Zawiercie. The study group received the same rehabilitative program but enriched with selected elements of the Bobath concept. On the first and last days of the study each of the patients was assessed with respect to self-sufficiency in performing daily activities using Functional Measure "Repty" (FMR - simplified version of Functional Independence Measure), upper extremity proximal motor control (the Frenchay Arm Test - FAT) and lower extremity strength (the Timed Up and Go Test - TUG).
Results:	The results revealed that patients with enriched rehabilitative program exhibited improvement in a greater number of physical functions as assessed by the FMR (improvement by 26.4%) compared to the control participants (14.28%). The Frenchay Arm Test and the Timed Up and Go Test showed improvement in upper extremity control and locomotion in the study and control participants. The mean reduction in TUG time was 2.5 s and 3.4 s in the control and study participants, respectively; the results are statistically significant. A FAT task, ie., lifting a cylinder and replacing it improved by a mean of 2 and 0.5 inches; there were also gains in the performance of other tasks such as drinking water from a glass and combing hair.
Conclusions:	The final results revealed an improvement of physical function in all patients. However, rehabilitation program enrichment with selected elements of the Bobath concept helped the patients achieve better functional recovery; a 3-week rehabilitation program more effectively contributed to improving self-sufficiency, locomotion and arm function.
Keywords:	stroke; Bobath (NDT) approach; evaluation of physical fitness

Corresponding author

Word count: 2513
Tables: 3
References: 21

Gabriela Walla
 Department of Kinesitherapy and Special Methods in Physiotherapy,
 The Jerzy Kukuczka Academy of Physical Education,
 40-065, Mikołowska 72B, Katowice, Poland.
 g.walla@awf.katowice.pl

INTRODUCTION

Due to its prevalence as well as biological, social and economic sequelae, a stroke or cerebrovascular accident (CVA) is the most serious of the vascular disorders of the central nervous system. As all clinically complex and multifactor (polyethiological) phenomena, a stroke is a disease entity that remains difficult to be accurately defined.

Stroke is defined by the World Health Organization as "a clinical syndrome consisting of rapidly developing clinical signs of focal or global disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin." The American National Institute of Neurological Disorders and Stroke defines stroke as a disorder in which the function of the central nervous system is "transiently or permanently affected by ischemia or bleeding and/or in which one or more vessels of the brain are primarily impaired by a pathological process" (Kozubski, Liberski 2008; Mazur et al. 1998). An updated definition allows a diagnosis of stroke also when symptoms or signs of focal brain dysfunction persist ≥ 24 hours, eg., in a patient who improved following thrombolytic treatment or had an ischemic lesion confirmed on neuroimaging (Sacco R.L. et al. 2013).

Stroke patients are the largest group of neurological patients who require rehabilitation care. Analyses of statistical data reveal that approximately 60% of stroke patients exhibit persistent symptoms and signs of focal brain damage including hemiplegia, reduced self-sufficiency in performing everyday activities, aphasia and, quite frequently, depression. Hence, the clinical picture is very complex and diversified regarding the severity of brain damage and peripheral manifestations. Continuous and complex rehabilitation program, finely-adapted to the patient's needs is among the key elements of stroke treatment. Early timing of rehabilitation promotes better outcome in stroke patients and can be more important than subsequent rehabilitation which should, in fact, be continued for a long time (Pasek et al. 2007).

In the case of adults with hemiplegia, Bobath therapy is based on a meticulous examination of the patient (special test) including their characteristics, ie., concomitant diseases (eg., hypertension, ischemic heart disease, diabetes mellitus), muscle tone (hyper- or hypotonia evaluated separately for the upper and lower extremities), global motor skills, the status of extero- and proprioception, mental and emotional state (the patient engagement in rehabilitation exercises, cooperation), motor capacity of particular body areas, equilibrium and defence reactions (Zembaty 2003).

Bobath trained therapists take into consideration disease stages such as hypotonia, hypertonia and relative recovery. However, opposite to other physiotherapy methods, the Bobath concept aims at

reducing spasticity, which impairs the sensation of movement. Bertha and Karel Bobath believed that the recovery to normal movement activity cannot stem from abnormal reflexes and movement patterns. Their concept is therefore based on inhibiting pathological and facilitating normal postural mechanisms, which precedes returning to activity (Nowotny 2004).

Stroke rehabilitation treatment programs have been presented by numerous authors. Kwolek (2002, 2004) and Pasek et al. (2007) suggest the following objectives of rehabilitation in the acute phase of recovery: prevention of complications of prolonged immobilization, reducing the risk of the patient developing abnormal movement patterns and persistent hypo- or hypertonia, prevention of the so called „non-use syndrome" and disturbances of orthostatic regulation, stimulation of central nervous system plasticity, diagnosis of language deficits and speech impairments, early speech and language therapy, providing the patient with exercise equipment and orthoses and teaching them how to use these devices (Laidler 2004). The second phase involves regenerative-compensatory approaches aimed at functional mobilization of the patient. Acute phase exercise regime gradually increases in difficulty; some exercises are eliminated and replaced by others, eg., reeducating "normal" movement patterns using proprioceptive neuromuscular facilitation (Bobath, Brunnström, Kabat), breathing exercises, gait relearning, occupational therapy in the gym, constraint-induced therapy (CIT) - a method to overcome learned non-use, Frenkel coordination and balance exercises, general fitness and whole-body exercises, sling exercises, water exercises, functional electrical stimulation (FES), music therapy and biofeedback (Opara 2007; Lennon, Stokes 2009).

In the third (chronic) phase of stroke recovery, the patient should gain optimum movement skills, improve in their general well-being and adapt to a new life situation. The second phase regime is used and the patient is instructed how to exercise at home; hand manipulation exercises are recommended to improve upper extremity function (Cywińska – Wasilewska, Nyka 2004; Grochmal 1986).

Aims of The Study

The main objective of this study was to demonstrate the beneficial effects of rehabilitation on self-sufficiency and recovery to everyday activities in patients after stroke.

The following research questions were formed:

1. Will Bobath therapy result in the improvement of upper extremity function?
2. Will Bobath therapy result in gait improvement?
3. Will Bobath therapy help the patient to become progressively more self-sufficient in performing everyday activities?

MATERIAL AND METHODS

The study group comprised 20 patients (11 women and 9 men) admitted to the Neurological Department of the District Hospital in Zabrze immediately after sustaining a stroke. On the first and the last day of the study, each patient underwent an evaluation of upper extremity function, gait and self-sufficiency in performing daily activities (Opara 2010; Michaluk 2007).

Patients who scored 3 or 5 points on the Functional Measure "Repty" (FMR - simplified version of Functional Independence Measure) were included in the study and randomly allocated into two groups of 10 participants each. The first was the control group whose members underwent a 3-week rehabilitation program used in the Neurological Department of the District Hospital in Zawiercie. The study group, on the other hand, received a rehabilitative program enriched with selected elements of the Bobath concept.

The mean age of the control participants (6 women and 4 men) was 70.9 (56-88) \pm 9.45 years while in the Bobath group (5 women and 5 men) it was 75.5 (68-88) \pm 6.5 years.

The evaluation was performed twice, ie., on the 1st and 21st days of the study using the following tests:

- the Functional Measure "Repty" (FMR) – assessment of self-sufficiency in performing everyday activities (Opara 2010),
- the Frenchay Arm Test (FAT) – assessment of upper extremity proximal motor control (Opara 2010),
- the Timed Up and Go test (TUG) – assessment of lower extremity strength (Michaluk 2007).

The Functional Measure "Repty" (FMR) is a universal tool, which may be used to assess self-sufficiency in several neurological and locomotor system diseases and disorders, and especially in patients after cerebrocranial injuries, those with peripheral nervous system injury, extrapyramidal system disorders, muscle diseases, low back pain, arthroses and amputations. FMR also allows including the patient in a particular disability category. Hence, the self-sufficiency range and need for assistance can be promptly determined.

The Frenchay Arm Test was another test which the patients underwent. The test measures seven basic arm functions, ie.,:

1. Opening a jar (a bilateral task).
2. Drawing a line while stabilizing a ruler (a bilateral task).
3. Lifting and replacing a cylinder of 2-inch diameter with the affected arm.
4. Lifting and replacing a cylinder of 0.5-inch diameter with the affected arm.
5. Picking up a glass with the affected arm to drink the water.
6. Combing hair with the affected arm.
7. removing and replacing a clothes peg positioned on a vertical dowel with the affected arm.

The patient was scored 1 point for each task. The maximum amount of points to be obtained was 7 (Opara 2010).

Timed „Up and Go” Test is a test frequently used to assess mobility in elderly individuals. It helps determine whether – when walking - the patient needs mobility aids or assistance of other people. The test measures the time that a person takes to rise from a chair (about 46 cm high), walk three metres, turn around, walk back to the chair, and sit down.

Patients with neurological disorders who can nevertheless maintain balance should score less than 10 seconds. Those who score more than 30 s need assistance of other people during the majority of movement activities (Michaluk 2007).

After randomization, all patients started a 3-week rehabilitation program used in the Neurological Department of the District Hospital in Zawiercie, which included:

- assisted exercises,
- active exercises,
- self-assisted exercises,
- active sling exercises,
- active resistance exercises,
- breathing exercises,
- circulation exercises,
- isometric exercises,
- reaching and maintaining vertical body position, gait relearning.

However, the rehabilitation of the study group was enriched with selected elements of the Bobath concept as follows:

- lower extremity exercises in the supine position,
- upper extremity exercises in the supine position,
- exercises in sitting (on the coach),
- exercises in sitting (on the chair),
- sit-to-stand exercises,
- standing exercises for balance,
- balance and weight shifting in standing and walking,
- suport on the affected arm.

Exercise sessions in both groups were administered five times a week, each of approximately 60 minutes.

The database was prepared using an Excel spreadsheet. Statistical analysis was carried out with Statistica 5.1. Mean values and standard deviations were calculated for all study parameters. The level of significance was set at $p < 0.05$. Since the Timed Up and Go test is measured in seconds, Student's t-test for dependent samples was used for intragroup and intergroup (study and control) comparisons. The remaining variables, ie., the FMR and FAT, presented in ordinal scales were analysed with the Wilcoxon signed-rank test. The parametric tests were used to assess physical fitness of the patients while performing everyday activities; a nonparametric equivalent of the

t-test, ie., the Mann-Whitney U test, was used to analyze Functional Measure "Repty" and Frenchay Arm Test scores both before and after the therapy.

RESULTS

The mean score on the Frenchay Arm test achieved by the Bobath participants before and after the rehabilitation program was 2.8 and 6.2 points, respectively (improvement by 127%). The control participants with their pre- and post-rehabilitation scores of 2.8 and 5.5 points, respectively improved by 96.4%.

Following the rehabilitation program, the Bobath Group exhibited a statistically significant improvement in the following tasks of the Frenchay Arm Test: lifting and replacing a cylinder of 0.5-inch and 2-inch diameter with the affected arm, picking up a glass with the affected arm to drink the water, combing hair with the affected arm and removing and replacing a clothes peg positioned on a vertical dowel with the affected arm.

The Control Group improved significantly in lifting and replacing a cylinder of 0.5-inch and 2-inch diameter with the affected arm, picking up a glass with the affected arm to drink the water and combing hair with the affected arm. The performance on other tasks of the Frenchay Arm did not change significantly.

In the Bobath Group, the functional ability by the Functional Measure Repty improved by 24.4%; the mean pre- and post-rehabilitation score was 63.6 and 80.4 points, respectively. The Control Group improved by 14.28%; the mean pre- and post-rehabilitation score was 56.7 and 64.8 points, respectively.

The following items assessed with the FMR improved significantly in the Bobath Group: eating, grooming, bathing, upper body dressing, applying orthoses and prostheses, lower body dressing, toileting, bed to chair or wheelchair transfer, toilet transfer, locomotion (ambulation or wheelchair, stairs). The performance on the remaining FMR items did not change significantly. The Control Group showed a significant improvement in the following items of the FMR: eating, grooming, bed to chair or wheelchair transfer, toilet transfer. The performance on the remaining FMR items did not change significantly.

Tables 1 and 2 present the scores of the Bobath and Control Groups in the Timed Up and Go test which assesses a person's mobility; the intergroup comparison is presented in Table 3.

The improvement achieved in the Bobath and Control Groups is not significant enough to declare the advantage of one method over the other (Table 3).

DISCUSSION

The dynamics and magnitude of functional improvement in the acute phase of stroke are well-determined. The majority of researchers believe that rehabilitation yields the best results in the first 3

Table 1. The Timed Up and Go Test – the Bobath Group

	X	± SD	Min.	Max.	p
TUG before rehabilitation	37.3	6.01	31	47	0.001
TUG after rehabilitation	33.9	6.60	25	45	

Table 2. The Timed Up and Go Test – the Control Group

	X	± SD	Min.	Max.	p
TUG before rehabilitation	38.1	4.97	32	46	0.001
TUG after rehabilitation	35.6	5.66	29	44	

Table 3. The Timed „Up and Go” Test – the Bobath and Control Groups

	Control group	Bobath group	p	Control group ± SD	Bobath group ± SD
TUG before rehabilitation	38.1	37.3	0.75	4.97	6.01
TUG after rehabilitation	35.6	33.9	0.54	5.66	6.60

months after stroke. Some other suggest that, even beyond this period, intensive rehabilitation may significantly improve functional capacity of the patient. However, studies on the effectiveness of rehabilitation in patients with mild-to-moderate disability are still scarce (Jaracz, Pochylska 1996).

The aim of this study was to assess self-sufficiency and performance of everyday activities in patients after stroke both before and after a rehabilitation program. Hence, we attempted to determine the importance of rehabilitation in patients with stroke.

The following were used to determine functional improvement: the Functional Measure "Repty", Frenchay Arm Test and the Timed Up and Go Test. All patients of the Control and Bobath groups scored better at the final assessment. Thus, it might be concluded that both rehabilitation programs ended with success. However, it should be noted that the Bobath participants, whose rehabilitation was enriched with

several elements of the Bobath Concept, showed better performance in everyday activities. The Bobath Group scored better on FMR, in particular on stair and self-care (bathing) tasks; this might have resulted from the Bobath Concept accentuating the patient's motivation, positive attitude to therapy and individual-centered approach. The rehabilitation program is adjusted to the patient's needs rather than pre-selected (Wolny et al. 2009).

Our results are in agreement with those obtained by Trochimiuk et al. (2009), whose study comprised 42 patients. The study subjects were assessed regarding functional capacity and performance of activities of everyday life using the Modified Barthel Index and Rivermead Mobility Index. The patients were assessed twice, i.e., at the start of hospital stay and at discharge. Exercise type and intensity were individually adjusted to the patient's condition and capability. Exercise session duration was not below 45 minutes. Neurophysiological treatment approaches were used including the Bobath Concept and PNF. The authors demonstrated that the patients' functional capacity and mobility improved after the rehabilitation program.

Jaracz i Pochylska (1996) carried out similar investigations and reached similar conclusions. The

study included 50 patients; the assessment was performed twice, prior to and after the treatment. Performance of everyday activities, upper extremity function and locomotion served as functional capacity parameters and were assessed with the Barthel Index, Arm Function Test and Functional Ambulation Classification. Over half of the patients who did not score satisfactorily on these tests improved following the rehabilitation program. The improvement in self-service and upper extremity function was more noticeable and more frequent than that in locomotion.

CONCLUSION

The obtained results allow us to draw the following conclusions:

1. Patients who received rehabilitation enriched with several elements of the Bobath Concept, improved in more everyday activities compared to the Control Group, and especially in stair walking and self-service tasks.
2. Improvement in hand function was demonstrated in the Bobath and Control Groups.
3. Gait improvement was also seen in both study groups.

REFERENCES

1. Critchley DJ, Pierson Z, Battersby G. Effect of pilates mat exercises and conventional exercise programmes on transversusabdominis and obliquusinternusabdominis activity: pilot randomised trial. *Man Ther*, 2011;16, 183-189
2. Ferreira PH, Ferreira ML, Hodges PW. Changes in recruitment of the abdominal muscles in people with low back pain: ultrasound measurement of muscle activity. *Spine*, 2004;29: 2560-2566.
3. Hebert JJ, Koppenhaver SL, Parent EC, Fritz JM. A systematic review of the reliability of rehabilitative ultrasound imaging for the quantitative assessment of the abdominal and lumbar trunk muscles. *Spine*, 2009; 11: 848-856
4. Hides J, Wilson S, Stanton W, et al. An MRI investigation into the function of the transversusabdominis muscle during "drawing-in" of the abdominal wall. *Spine*, 2006; 31: 175-178
5. Hodges PW. Is there a role for transversusabdominis in lumbo-pelvic stability? *Man Ther*, 1999; 4: 74-86
6. Hodges PW, Pengel LH, Herbert RD, Gandevia SC. Measurement of muscle contraction with ultrasound imaging. *MuscleNerve*, 2003; 27(6):682-92
7. Ishida H, Watanabe S. Changes in lateral abdominal muscles` thickness immediately after the abdominal drawing-in maneuver and maximum expiration. *J BodywMovTher*, 2013; 17: 254-258
8. Koppenhaver SL, Hebert JJ, Fritz JM, Parent EC, Teyhen DS, Magel JS. Reliability of rehabilitative ultrasound imaging of the transversusabdominis and lumbar multifidus muscles. *ArchPhysMedRehabil*, 2009a;90:87-94
9. Koppenhaver SL, Hebert JJ, Parent EC, Fritz JM. Rehabilitative ultrasound imaging is a valid measure of trunk muscle size and activation during most isometric sub-maximal contractions: a systematic review. *Aust J Physiother*, 2009b; 55: 153-169
10. Linek P., Saulicz E., Wolny T., Myśliwiec A., Kokosz M.: Lateral abdominal muscle size at rest and during abdominal drawing-in manoeuvre in healthy adolescents. *Manual Therapy*, 2014a; 07 18. pii: S1356-689X(14)00137-4. doi: 10.1016/j.math.2014.07.009 [Epub ahead of print]
11. Linek P., Saulicz E., Wolny T., Myśliwiec A.: Intra-rater reliability of B-Mode ultrasound imaging of the abdominal muscles in healthy adolescents during the active straight leg raise test. *PM&R*, 2014b; 08 1. pii: S1934-1482(14)00366-9. doi: 10.1016/j.pmrj.2014.07.007. [Epub ahead of print]
12. Linek P., Saulicz E., Wolny T., Myśliwiec A.: Reliability of B-mode ultrasound imaging of the abdominal muscles in healthy adolescents in different body positions. *Journal of Ultrasound in Medicine*, 2014c; 06: 1049-1056
13. Marras WS, Davis KG, Heaney CA, Maronitis AB, Allread WG. The influence of psychosocial stress, gender and personality on mechanical loading of the lumbar spine. *Spine*, 2000;25:3045-3054

14. McMeeken JM, Beith ID, Newham DJ, Milligan P, Critchley DJ. The relationship between EMG and change in thickness of transversusabdominis. *ClinBiomech (Bristol, Avon)*, 2004 May;19(4): 337-42
15. Mens JM, Vleeming A, Snijders CJ, Koes BW, Stam HJ. Reliability and validity of the active straight leg raise test in posterior pelvic pain since pregnancy. *Spine*, 2001(Phila Pa 1976)
16. Mens JM, Vleeming A, Snijders CJ, Koes BW, Stam HJ. Validity of the active straight leg raise test for measuring disease severity in patients with posterior pelvic pain after pregnancy. *Spine*, (Phila Pa 1976) 2002 Jan 15;27(2):196-200
17. Myśliwiec A., Kuszewski M., Saulicz E., Linek P., Wolny T., Białach M., Połuszny A.: Ocena symetrii mięśnia poprzecznego brzucha w badaniu ultrasonograficznym. *Ortopedia Traumatologia Rehabilitacja*, 2014; 14(4), 427-434
18. O'Sullivan PB, Beales DJ, Beetham JA, et al. Altered motor control strategies in subjects with sacroiliac joint pain during the active straight leg raise test. *Spine*, 2002; 27:E1-8
19. Shrout PE, Fleiss JL. Intraclass correlation: Uses in assessing rater reliability. *Psychol Bull*, 1979;86:420-428
20. Teyhen DS, Williamson JN, Carlson NH, et al. Ultrasound characteristics of the deep abdominal muscles during the active straight leg raise test. *ArchPhysMedRehabil*, 2009; 90: 761-767
21. Yang HS, Yoo JW, Lee BA, Choi CK, You JH. Inter-tester and intra-tester reliability of ultrasound imaging measurements of abdominal muscles in adolescents with and without idiopathic scoliosis: a case-controlled study. *BiomedMaterEng*, 2014;24(1):453-8. doi: 10.3233/BME-130830