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## POSTURAL CONTROL AND BALANCE REACTIONS IN PATIENTS WITH ISCHEMIC STROKE IN THE CHRONIC PERIOD

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### INTRODUCTION

Postural control is the ability to retain the center of gravity of the body on the support surface while sitting and in standing position. It is a dynamic phenomenon which combines simultaneously mobility and stability of a necessary condition for lending and retaining the required body posture when is necessary to perform controlled and coordinated motor activity [11]. Impaired balance reduces the ability of independence in daily life [17]. Patients with stroke have limited physical activity that changes the sensorimotor control, postural control, the musculoskeletal system and the autonomous control. This creates progressive cardiovascular risk for development of disease, and predisposition to recurrent stroke [8, 13, 14]. Due to the long-lasting constraints, physical performance and the social adaptation of the patients has been hampered [2].

In stroke, abnormal postural response can not be due only to the unilateral sensorimotor dysfunction. It is known that stroke can reduce the vestibular function and that this may affect the postural reaction on both sides of the body with violation of the vestibulo-ocular reflex [5]. In patients with stroke is impaired ability for transferring the burden in swing phase. Patients have difficulties in maintaining upright standing position with the affected side, have difficulty controlling the muscles and difficulty to respond to proprioceptive feedback effect, providing additional balance difficulties. Balance in patients with stroke can be further aggravated by postural hypotension, adverse drug effects, mental status, abnormal vision, and other conditions associated with neuropathy, arthritis, and altered cognitive status [15].

The plasticity of the central nervous system is necessary to re-establish the balance while sitting and standing, in patients with stroke [10]. But still is not clear whether the improvements to sitting balance leads to an improvement in straightening, standing, sitting and walking [12].

Kinesitherapeutic means which in modern neurorehabilitation are often applied to improve the postural control, balance reactions and the daily capabilities of the patients with stroke, are using treatment within Bobath methods [3], stimulation of sensory function and biofeedback [19], various exercises, including dual task [9] and sling exercise therapy [6].

According to Gencheva, N., (2003) the exercises with Swiss Ball can significantly improve muscle strength and endurance, coordination of movement and balance control of the body, both in sitting and standing position [7]. In a study of the effect of the application of the kinesitherapeutic methodology with exercises on a Swiss ball, Dimitrova, A., et al., (2007) found a positive effect on the static balance in patients with ischemic stroke in the vertebral-basilar system in the subacute period [4].

**The aim** of this study was to investigate the influence of specialized kinesitherapeutic methodology (SKTM) on static and functional balance reactions in patients with ischemic stroke in the chronic period, which is developed on the grounds of the principles of motor control, motor learning and modern guidelines to neurodevelopmental treatment (NDT).

## METHODOLOGY

In the study were included 11 patients with chronic right- sided (63.6%) and left-sided (36.4%) hemiparesis (Tabl. 1) after ischemic stroke within 3 months and one year duration of the disease. The patients studied were evaluated on performance of Berg Balance Scale (BBS) at the beginning of the 10th day, 1st month and 3 months. Performance of Berg Balance Scale has strong psychometric properties and that is valuable in the evaluation of clinical change of the balance after stroke [1].

The original test involves implementation of 14 tasks with elevated difficulty, reflecting the normal activities of daily living (rising from a seated position, taking an object from the floor, standing position on one leg, turning, reaching, step on the block). The first 5 assignments are used to assess the main balance capacity and the remaining 9 (6 to 14 assignments) include more complicated balance tasks. Evaluating the possibilities of the studied patients to maintain the balance while performing tasks with a gradual reduction in the support surface, with weight transfer of the body to turn and reach. The first task is performed by seating and ends with standing position on one leg. The assessment uses a 5 point scale (0-4) depending on the possibilities to perform a task. These levels are based on precisely defined criteria [18].

**Tabl.1** Distribution by sex and hemiparetic side

Sex / hemiparetic side	Frequency	Percent	Valid Percent	Cumulative Percent
Man	5	45.5	45.5	45.5
Woman	6	54.5	54.5	100.0
Right-sided	7	63.6		
Left-sided	4	36.4		
Total	11	100.0	100.0	

**Tabl.2.** Descriptive characteristics of the patients by age, weight, height, a stage of functional recovery of Brunnstrom and Ashworth's test for spasticity at baseline of study.

Parameters	Minimum	Maximum	Mean	Std. Deviation
Age	53	76	65.00	6.372
Weight	60	82	71.27	7.072
Height	152	174	163.64	6.727
Brunnstrom-upper limb			3.73	.647
Brunnstrom-lower limb			4.36	.505
Ashworth-upper limb			2.182	.7508
Ashworthlower limb			1.636	.3931

The clinical characteristics of the patients are given in Table. 2, where the descriptive characteristics of the studied patients are specified by age, weight and height, the mean and standard deviation of the scores of the stage of functional recovery of Brunnstrom and Ashworth's test for spasticity at baseline of study. For presence of a homogeneity in the study, patients were selected by the following criteria: have not severe respiratory insufficiency, cardiovascular insufficiency (third functional class), uncontrolled diabetes mellitus, cognitive and memory disorders, acute thrombophlebitis, severe decubital ulcer, severe orthopedic disorders impaired coordination and gait, ischemic heart disease, malignancies, severe progressive neurological disorders. The patients gave a written consent to participate in the study. All patients were able to move around alone or with help, and without serious problems in communication.

The daily specialized kinesitherapy is with moderate overload. In the introductory part, the exercises are focused on preparing the body for the forthcoming exercises, a gradual adaptation of the cardiovascular system (chest and diaphragmatic breathing). The main part of kinesitherapy includes exercises to move from occipital lying to standing position, upper limb exercises and shoulder girdle control, lower limb exercises and control of the trunk, pelvis, and walking. The final part includes relaxation exercises for patients. After 10-day daily kinesitherapy, patients have made adaptations for home rehabilitation program for 3 months.

The resulting data were statistically processed using the descriptive analysis. Paired Samples Test is used to compare the parameters at the beginning of the 10 days, the 1st and 3rd month after kinesitherapy.

**Tabl.3.** Mean and standard deviation of the static and functional balance of the 1st day, 10 day, 1st month, 3rd month

	Mean	Std. Deviation	Std. Error Mean
static balance _1 <sup>st</sup> day	1.2727	.79415	.23945
functional balance _1 <sup>st</sup> day	1.4545	.84778	.25561
static balance _10 day	3.0227	.45352	.13674
functional balance _10 day	3.2909	.46358	.13978
static balance _1 <sup>st</sup> month	3.5909	.35834	.10804
functional balance _1 <sup>st</sup> month	3.7364	.29419	.08870
static balance _3 <sup>rd</sup> month	3.9318	.11677	.03521
functional balance _3 <sup>rd</sup> month	3.9545	.06876	.02073

**Tabl.4.** Paired Samples Test of the static and functional balance of the 1st day, 10 day, 1st month, 3rd month

		Paired Differences - Static / Functional Balance					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
Pairs		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Static - functional - 1 <sup>st</sup> day	-.18182	.34948	.10537	-.41660	.05297	-1.725	10	.115
Pair 2	Static - functional - 10 day	-.26818	.31644	.09541	-.48077	-.05559	-2.811	10	.018
Pair 3	Static - functional - 1 <sup>st</sup> month	-.14545	.29534	.08905	-.34387	.05296	-1.633	10	.133
Pair 4	Static - functional - 3 <sup>rd</sup> month	-.02273	.10090	.03042	-.09052	.04506	-.747	10	.472

## RESULTS

Descriptive characteristics by age, weight and height of the studied patients are presented in Table 2. At the study start, have been introduced average values and standard deviation of scores along the stage of functional recovery by Brunnstrom and Ashworth spasticity test. From the values clearly appears that the patients are with mild damage after ischemic stroke, the assessment of the stage of functional recovery by Brunnstrom for upper limb is 3.73 for lower limb - 4.36, and the evaluation of the test for spasticity in Ashworth for upper limb is 2.18 and lower limb - 1.63.

It was found significant change in the mean and standard deviation of static and functional balance with the crisper changes in the value of 10 days (Table 3).

In Table. 4 presents the results of the changes in static and functional balance of the monitored patients. Performance of 1<sup>st</sup> day, 1<sup>st</sup> month and 3<sup>rd</sup> months are not significantly changed ( $p > 0.1$ ). On the 10th day after the beginning of treatment the data were statistically significant ( $p = 0.018$ ). The static balance is significantly lower than the functional improvement, at a value of significance of  $p < 0.05$ .

In Table. 5 shows the changes in the balance possibilities of the monitored patients being referred to the difference in performance between the 10th and the 1st day, 1st month, 10th day and 3<sup>rd</sup> month and 1<sup>st</sup> month. There is improvement in absolute values during treatment, but the statistical significance of the changes is not established.

## DISCUSSION

From the present study establishing that SKTM has a tendency to improve static and functional balance in patients studied. To normalize the control between the unaffected and affected side of the body, are used exercises for transition from lying occipital position to standing position, self-taught in changing the initial position and gradual verticalization. The exercises for upper limb and shoulder girdle control normalize the control of movements of the upper limb, control of the healthy and the affected side of the body and facilitate the performance of the daily living activities.

Exercises for lower limb and control of the trunk and pelvis normalize the control of movement of the lower limb, control of the healthy and the affected side of the body, improve the balance reactions of the body, better coordination and consistency of the motor responses, improved static balance and the postural control (optimal position of the trunk and lower limbs), stimulate response in m.quadriceps femoris and facilitate walking. Walking exercises normalize control of the trunk and the upper limbs, normalize the control of the healthy and the affected side of the body, improve the balance reactions, better coordination and consistency of the motor response, improved dynamic control and facilitate movement. Similar results were indicated by other authors, arguing that the exercise of the unaffected upper limb during sitting, in which patients are trained to transfer the burden of the body (arm's length), have a positive effect on the seating balance [12]. The exercises in symmetrical standing and seating have a positive effect on the lateral distribution of the burden during these changing situations and the speed of implementation of these activities [16].

## CONCLUSIONS

The applied by us methodology continued later as an exercise program at home, is with tendency to improve postural control and balance reactions in patients with ischemic stroke in the chronic period.

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