ORIGINAL ARTICLE

PHYSICAL PROCEDURES IN POST-STROKE PATIENTS. CLINICAL AND SOCIAL PROBLEMS

Włodzisław Kuliński[1,2], Anna Pasieka[2]
[1]DEPARTMENT OF REHABILITATION, MILITARY INSTITUTE OF MEDICINE, WARSAW, POLAND
[2]COLLEGIUM MEDICUM, JAN KOCHANOWSKI UNIVERSITY, KIELCE, POLAND

ABSTRACT
The aim: To assess the effects of physical therapy on the general condition of stroke patients and their level of independence with respect to functioning after stroke.
Materials and methods: The study was conducted in patients receiving care and rehabilitation at the "Tęczowe Zacisze" centre in Wola Kopcowa. The study group included both residents and out-patients undergoing rehabilitation at the centre. The study assessed a total of 25 patients (14 women and 11 men) aged 50 years and older and analysed the quality of life with respect to activities of daily living and mobility as well as the effects of physical therapy on functioning in stroke patients.
Results: The use of comprehensive rehabilitation in study patients improved their mobility with respect to using the stairs and walking on a flat surface, improved their ability to perform self-care activities when using the toilet, and helped them eat meals, get dressed, and bathe unassisted.
Conclusions: 1. Post-stroke rehabilitation should be comprehensive, complex, and adjusted to the current physical and motor abilities of the patient. 2. The number of patients undergoing early and comprehensive rehabilitation remains too low. It is important to inform the public at large about the possibility of receiving physical therapy after stroke.

KEY WORDS: stroke, physical therapy, clinical and social study

INTRODUCTION

According to the World Health Organisation (WHO), stroke is defined as "rapidly developed 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 of vascular origin". In Europe, stroke occurs in 1,000,000 people a year, with one third dying and one third experiencing permanent symptoms of disability. In Poland, stroke affects 60,000 people annually; half of these people die within one year and the rest are left with permanent disability [1-5].

The main classification of stroke is as follows:

a) **ischaemic stroke**, which is responsible for 80-85% of all cases. It is further divided based on its pathomechanism into thromboembolic (14-40%), embolic (15-30%), and lacunar;

b) **haemorrhagic stroke**, which is responsible for approximately 10-20% of all cases.

There are multiple risk factors for stroke. Modifiable risk factors for stroke include hypertension, atrial fibrillation, coronary disease, myocardial infarction, congestive circulatory failure, and diabetes [6-12]. Physical inactivity contributes to an increased risk of stroke and smoking is an absolute risk factor for stroke [13-16]. Non-modifiable risk factors for stroke include age, gender, and race.

Stroke patients experience a number of sequelae, such as:
- Paralysis or paresis of half of the body (hemiplegia or hemiparesis)
- Unilateral sensory disturbances
- Aphasia (speech disturbances)
- Impairment of higher neurological functions
- Visual impairment
- Abnormal posture and limb positions
- Gait problems caused by motor deficits
- Apraxia, i.e. inability to perform learned purposeful movements
- Spasticity (abnormal, increased muscle tone)
- Hemineglect
- A lower level of independence or lack of independence
- Depression

Stroke is diagnosed based on the following imaging studies:
- Computed tomography (CT) helps diagnose structural changes developed in the ischaemic process and differentiate between ischaemic and haemorrhagic stroke
- Magnetic resonance imaging (MRI)

The rehabilitation process in stroke patients is divided into three main periods:
- First period – acute, lasting several days to several weeks
- Second period – period of regeneration and compensation, lasting from several weeks to several months, or even up to more than ten months
- Chronic period – after one year from the onset of stroke.

The main aim of rehabilitation in stroke patients is to improve their level of functional independence [17-25].

Fig.1. A magnetic resonance image showing acute stroke

EARLY REHABILITATION PERIOD

The in-hospital rehabilitation period lasts several days to several weeks. During this period, the rehabilitation process depends on the cause of stroke; its duration should be 2 to 5 days in ischaemic stroke and approximately 4 weeks in haemorrhagic stroke. During this phase, physiotherapy is aimed at preventing decubitus ulcers, abnormal limb positions, and pulmonary complications as well as regulating urinary bladder function and maintaining contact with the patient.

The following physiotherapy procedures should be performed in the acute stroke period:

- Breathing exercises, which are aimed at preventing pulmonary complications. They should be performed 3 to 5 times daily and include chest percussion
- Active exercises of non-paretic limbs: 10 to 15-minute sessions performed twice daily
- Passive exercises of paretic limbs: 30 repetitions for each movement in the joint, performed 3 to 5 times daily
- Pulley exercises with a band performed in bed: approximately 15-minute sessions 2 to 3 times daily
- Classic massage of paralysed limbs: once or twice daily

Active mobilisation should be introduced no later than on the second day after admission.

SECOND AND THIRD REHABILITATION PERIOD

In the second period, patients undergo functional mobilisation. New elements are gradually added to the physiotherapeutic methods used in the first period, and some methods are replaced with others. During this period, patient management is aimed at eliminating excessive spasticity, preventing joint contractures, achieving a maximum level of mental and physical abilities, adjusting to the new, changed life situation, and improving the quality of life.

The third (chronic) period continues throughout the rest of the patient's life. In this period, physiotherapy is used to improve gait and limb function and to achieve a maximum level of independence and mobility. Secondary prevention is very important in stroke patients. During this period, stroke patients are recommended to undergo rehabilitation in a health resort, for instance in Ciechocinek, Busko Zdrój, Konstancin or Kołobrzeg.

The following forms of physical therapy are used: heat therapy procedures, cryostimulation, electrotherapy, magnetic field therapy, ultrasound therapy, laser therapy, massage, and hydrobalneological procedures [23-25].

THE AIM

The aim of the study was to assess the effects of physical therapy on the general condition of stroke patients and their level of independence after stroke.

Research problems and hypotheses:

1. Ischaemic stroke is more common than haemorrhagic stroke;
2. Gender is associated with improvements in the level of mobility;
3. Starting rehabilitation on the first day of therapy improves the ability to perform self-care activities.

A null hypothesis is accepted which assumes that there is no correlation between the variables.

MATERIALS AND METHODS

The hypotheses were verified with the use of tests appropriate to determine the presence of a correlation between qualitative variables (measured on a nominal or ordinal scale): chi-squared test, chi-squared test corrected for continuity in the case of 2x2 tables, and Fisher's test. A result below the statistical significance level of $p = 0.05$ allows for the rejection of the null hypothesis and acceptance of the alternative hypothesis assuming that there is a correlation between the variables.

The study analysed whether sociogeographic variables accounted for differences in:

- Types of stroke
- Level of independence in eating meals, bathing, getting dressed, and using the toilet
- Level of mobility

The study was conducted in 25 stroke patients receiving care and rehabilitation at the "Tęczowe Zacisze" centre in Wola Kopcowa (Świętokrzyskie Voivodeship). The follow-up period was 3 months.

The statistical population showed certain common characteristics as well as variables, which were related to the basic features used to individualise the units, such as baseline condition of the patient, time from stroke, number, patient-rated independence, etc.

A vast majority of study patients were over 70 years old. 48% of study patients were aged 50 to 69 years. The study group included 14 women, who constituted the majority of study patients (56%), and 11 men (44%) (Table I).

Table I. Study group characteristics (N=25).

	N	[%]
Age of study patients		
50-69	12	48.0
70 and older	13	52.0
Gender of study patients		
Female	14	56.0
Male	11	44.0
Type of stroke		
Haemorrhagic	14	56.0
Ischaemic	11	44.0
Time from stroke		
A year ago	7	28.0
Two years ago	12	48.0
Three years ago and more	6	24.0

Table II. The condition of patients immediately after a stroke (N=25).

	N	[%]
Getting dressed immediately after stroke		
I am independent	1	4.0
I need partial help	4	16.0
I am unable to get dressed unassisted, I need someone to help me	20	80.0
Using the toilet immediately after stroke		
I am able to get to the toilet and use it unassisted	3	12.0
I need someone to help me	22	88.0
Mobility on a flat surface immediately after stroke		
I am independent	1	4.0
I do not need anyone to help me, but I do need walking aids	1	4.0
I need one person to support me	1	4.0
I use a wheelchair unassisted	5	20.0
I cannot move unassisted, I am dependent on someone's help	17	68.0
Mobility immediately after stroke: using stairs		
I am independent	2	8.0
I need physical help and support	22	92.0
Moving from bed to wheelchair or chair immediately after stroke		
I am independent	3	12.0
I need one person to help me	3	12.0
I need two people to help me	6	24.0
I am unable to move from bed unassisted, I cannot maintain balance when sitting	13	52.0

Haemorrhagic stroke was the more common type of stroke in the study group (56%) (Table I). At the time of the study, as many as 24% of study patients had been experiencing consequences of stroke for three years or more and 28% of study patients had been suffering from them for only a year (Table I).

A vast majority of study patients (72%) were unable to prepare meals unassisted, let alone eat them without help. Only one person (4%) was able to prepare and eat meals unassisted. After stroke, a vast majority of study patients (92%) required help with bathing and washing. Only two patients (8%) claimed to be able to perform these tasks unassisted.

After stroke, a vast majority of study patients (80%) were unable to get dressed unassisted and needed someone to help them (Table II). 88% of study patients needed help to use the toilet and only three people (12%) declared complete independence with respect to this task. Most study patients were unable to walk or move unassisted and needed help from other people (68%) (Table II). Most patients needed physical help and support to be able to use the stairs (92%). Immediately after stroke, the majority of patients (56%) were unable to sit up from a recumbent position unassisted or maintain balance when sitting; only two people (8%) were completely independent (Table II). Immediately after stroke, most study patients were unable to move from bed to chair or wheelchair unassisted as they could not maintain balance when sitting (52%); six study patients needed the help of two people to be able to move from bed to chair or wheelchair (24%) (Table II).

In the majority of cases (84%), rehabilitation was performed from the onset of stroke. Most study patients (95.2%) described their continued rehabilitation as comprehensive.

All study patients (100%) continued rehabilitation after being discharged from hospital. After discharge, study patients usually underwent therapy at least five days a week (44%) or between one and two times a week (40%). Only four patients (16%) participated in rehabilitation 3 to 4 times a week. In a vast majority of cases, patients underwent physical therapy at home with the active participation of a physiotherapist (88%).

A vast majority of study patients (64%) after rehabilitation were able to eat meals unassisted and only needed help to prepare them (Table III). After rehabilitation, a vast majority of study patients were able to get dressed unassisted (48%) or needed only partial help (44%) with getting dressed. After rehabilitation, a vast majority of study patients (56%) were able to get to the toilet unassisted and perform the necessary self-care activities. As many as 11 people (44%) continued to declare that they needed someone to help them with using the toilet (Table III).

A vast majority of study patients did not require anyone to help them, but needed walking aids (44%) or were completely independent (32%) (Table III). After rehabilitation, most patients were either able to sit unassisted, but needed help with sitting up (52%), or were completely independent (48%).

Table III. Improvements after rehabilitation (N=25).

	N	[%]
Change in self-care activities: eating meals		
I prepare and eat meals unassisted	7	28.0
I need help with preparing meals	16	64.0
I am dependent	2	8.0
Change in self-care activities: getting dressed		
I am independent	12	48.0
I need partial help	11	44.0
I am unable to get dressed unassisted, I need help	2	8.0
Change in self-care activities: using the toilet		
I am able to get to the toilet and use it unassisted	14	56.0
I need someone to help me	11	44.0
Effects of rehabilitation on using stairs and walking on a flat surface		
I am walking on a flat surface	4	16.0
I am independent	8	32.0
I do not need anyone to help me, but I do need walking aids	11	44.0
I need one person to support me	1	4.0
I use a wheelchair unassisted	1	4.0

After rehabilitation, 48% of study patients were independent or needed the help of one person to move from bed to wheelchair or chair. All study patients had a positive opinion about their rehabilitation.

RESULTS

Hypothesis: There is a correlation between type of stroke and the gender of study patients.

An analysis based on Fisher's exact test was performed (due to the fact that the conditions of using the χ^2 test had not been met). The analysis studied the following variables: Type of stroke and gender (Table IV).

The result turned out to be not statistically significant ($p > 0.05$). The different types of stroke occurred in similar proportions of men and women; therefore, the type of stroke did not depend on the gender of study patients ($p > 0.05$).

The level of independence in eating meals, bathing, getting dressed, and using the toilet, or the individual activities themselves (and patients' independence in performing them), depend on the gender and age of study patients.

The study aimed to verify the presence of a statistically significant correlation between the following two variables: Immediately after stroke: bathing and age (Table V).

The test result ($p > 0.05$) was not statistically significant. The level of independence with respect to bathing did not differ depending on the age of study patients (Table VI).

There was no statistically significant correlation between the variables Immediately after stroke: bathing and gender. The level of independence with respect to bathing did not differ in a statistically significant manner depending on the gender of study patients.

The study aimed to verify the presence of a statistically significant correlation between the following two variables: Immediately after stroke: getting dressed and age (Table VII).

The test result ($p > 0.05$) was not statistically significant. Patients from different age groups did not differ in terms of their level of independence in getting dressed.

Table IV. Types of stroke vs gender.

			Gender		Test result
			Female	**Male**	
Type of stroke	Haemorrhagic	N	9	5	
		[%]	64.3%	45.5%	
	Ischaemic	N	5	6	$p = 0.296$
		[%]	35.7%	54.5%	
Total [%]		N	14	11	
			100.0%	100.0%	

p – significance

Table V. Bathing after stroke vs age.

			Age		Test result
			50-69	**70 and older**	
Immediately after stroke: bathing	I am independent	N	1	1	
		[%]	8.3%	7.7%	$\chi^2 = 0.001$
	I need someone to help me	N	11	12	df = 1
		[%]	91.7%	92.3%	$p = 1.000$
Total [%]		N	12	13	
			100.0%	100.0%	

p – significance; χ^2 – test statistic; df – degrees of freedom

Table VI. Chi-squared: bathing after stroke vs gender.

			Gender		Test result
			Female	Male	
Immediately after stroke: bathing	I am independent	N	0	2	$\chi^2 = 0.848$ df = 1 $p = 0.357$
		[%]	0.0%	18.2%	
	I need someone to help me	N	14	9	
		[%]	100.0%	81.8%	
	Total	N	14	11	
	[%]		100.0%	100.0%	

p – significance; χ^2 – test statistic; df – degrees of freedom

Table VII. Getting dressed vs age.

			Age		Test result
			50-69	70 and older	
Immediately after stroke: getting dressed	I am independent	N	0	1	
		[%]	0.0%	7.7%	
	I need partial help	N	2	2	
		[%]	16.7%	15.4%	$p = 1.000$
	I am unable to get dressed unassisted, I need someone to help me	N	10	10	
		[%]	83.3%	76.9%	
	Total	N	12	13	
	[%]		100.0%	100.0%	

Table VIII. Using the toilet vs age.

			Age		Test result
			50-69	70 and older	
Immediately after stroke: using the toilet	I am able to get to the toilet and use it unassisted	N	1	2	$\chi^2 = 0.000$ df = 1 $p = 1.000$
		[%]	8.3%	15.4%	
	I need someone to help me	N	11	11	
		[%]	91.7%	84.6%	
	Total	N	12	13	
	[%]		100.0%	100.0%	

p – significance; $\chi 2$ – test statistic; df – degrees of freedom

Table IX. Using the toilet after stroke vs gender.

			Gender		Test result
			Female	Male	
Immediately after stroke: using the toilet	I am able to get to the toilet and use it unassisted	N	0	3	$\chi^2 = 2.141$ df = 1 $p = 0.143$
		[%]	0.0%	27.3%	
	I need someone to help me	N	14	8	
		[%]	100.0%	72.7%	
	Total	N	14	11	
	[%]		100.0%	100.0%	

p – significance; χ^2 – test statistic; df – degrees of freedom

An analysis was performed to verify the presence of a correlation between the following two variables: Immediately after stroke: using the toilet and age (Table VIII).

The test result ($p > 0.05$) was not statistically significant. Patients from different age groups did not differ in terms of their level of independence in using the toilet.

The same variables (activities) were analysed with respect to gender. Men and women did not differ in terms of their level of independence in getting dressed.

An analysis was performed to verify the presence of a statisti-

Table X. Moving from bed to wheelchair or chair vs age.

			Age		Test result
			50-69	70 and older	
Mobility: moving from bed to wheelchair or chair	I am independent	N	1	2	p = 1.000
		%	8.3%	15.4%	
	I need one person to help me	N	2	1	
		%	16.7%	7.7%	
	I need two people to help me	N	3	3	
		%	25.0%	23.1%	
	I am unable to move from bed unassisted, I cannot maintain balance when sitting	N	6	7	
		%	50.0%	53.8%	
	Total	N	12	13	
	%		100.0%	100.0%	

p – significance; χ^2 – test statistic; df – degrees of freedom

cally significant correlation between the following two variables: Immediately after stroke: using the toilet and gender (Table IX).

Men and women did not differ in terms of independence in using the toilet.

An analysis was performed to verify the presence of a correlation between the following two variables: Moving from bed to wheelchair or chair and age (Table X).

The test result (p > 0.05) was not statistically significant, which means that the hypothesis assuming the presence of a correlation between the variables was not confirmed.

DISCUSSION

Stroke is a life-threatening condition and constitutes the third most common cause of death worldwide, after heart disease and cancer; in Central and South-East Asia, stroke is the leading cause of death.

An estimated 5.5 million people die of stroke every year. There are approximately 50 million people affected by stroke worldwide. Stroke is a leading cause of permanent physical impairment and loss of independence in everyday life among adults [1-10].

In Poland, epidemiological studies have shown that 60,000 people experience symptoms of stroke every year; half of these people die within one year and the rest are left with permanent disability.

The present study was conducted in patients receiving care and rehabilitation at the "Tęczowe Zacisze" centre in Wola Kopcowa and included both residents and out-patients undergoing rehabilitation at the centre. The study assessed a total of 25 patients (14 women and 11 men) aged 50 years and older.

Most study patients had haemorrhagic stroke (56% of all cases). Haemorrhagic stroke was more common in women (64.3%) than men (45.5%).

Immediately after stroke, a vast majority of study patients were unable to eat and prepare meals unassisted.

After stroke, a vast majority of study patients needed help with bathing (100% of women and 81.8% of men).

Immediately after stroke, almost all study patients needed complete or partial help with getting dressed. After treat-

ment, most patients became independent (48%) or needed only some help (44%) with respect to getting dressed.

After stroke, a vast majority of study patients needed help to be able to get to the toilet and perform the necessary self-care activities. After rehabilitation, most study patients (56%) became independent and were able to get to the bathroom and perform the necessary self-care activities while using the toilet unassisted.

Immediately after stroke, a vast majority of patients were unable to sit up or needed help with sitting up and were able to remain sitting. After treatment, all study patients were able to sit unassisted and only 52% of study patients needed help in order to sit up from a recumbent position.

After stroke, a vast majority of study patients were unable to move from bed to chair or wheelchair or needed considerable help with this task. After treatment, most patients were able to move from bed to chair or wheelchair unassisted (48%) or needed only one person to help them (48%).

Seeing that the number of people undergoing early comprehensive rehabilitation remains too low, it is important to inform patients that they can and should receive rehabilitation and that it should start soon after stroke.

Numerous studies on stroke confirm the usefulness of comprehensive physical therapy, describing its positive effects on the course of stroke and the functional status of stroke patients [19-25].

According to a study by Galasińska K, Buchalski P, and Gajewska E, rehabilitation of stroke patients should be adjusted to their individual situation and abilities, which guarantees recovery and allows stroke patients to participate in family and public life [22].

The results of the present study are similar to the results reported by other authors. They confirm the efficacy of rehabilitation in patients after ischaemic and haemorrhagic stroke and prove that the treatment used in these patients had a beneficial effect on their quality of life.

CONCLUSIONS

1. Stroke is a clinical and social problem.
2. The physical therapy and rehabilitation used in study patients improved their level of mobility when walking

on a flat surface and using the stairs and improved their self-care abilities with respect to eating and preparing meals, getting dressed, and using the toilet.

3. Post-stroke rehabilitation should be comprehensive, complex, and adjusted to the current physical and motor abilities of the patient.

4. Management of stroke patients is based on physical therapy.

REFERENCES

1. Prabhakaran S, Ruff I, Bernstein RA. Acute stroke intervention. A systemic review. JAMA 2015;313(14):1451-62.
2. Erbguth F. Acute stroke treatment in old age. Z Gerontol Geriatr. 2020;53(1):59-74.
3. Fisher M, Moores L, Alsharif MN, Paganini-Hill A. Definition and implications of the preventable stroke. JAMA Neurol. 2016;73(2):186-9.
4. Rivard L, Khairy P, Talajic M, et al. Blinded randomized trial of anticoagulation to prevent ischemic stroke and neurocognitive impairment in atrial fibrillation (BRAIN-AF): methods and design. Can J Cardiol. 2019;35(8):1069-1077.
5. Paquin K, Crawley J, Harris JE, Horton S. Survivors of chronic stroke-participant evaluations of commercial gaming for rehabilitation. Disabil Rehabil. 2016;38(21):2144-52.
6. Lou S, Carstensen K, Jorgensen CR, Nielsen CP. Stroke patients' and informal carers' experiences with life after stroke: an overview of qualitative systematic reviews. Disabil Rehabil. 2017;39(3):301-313.
7. Purcell S, Scott P, Gustafsson L, Molineux M. Stroke survivors' experiences of occupation in hospital-based stroke rehabilitation: a qualitative exploration. Disabil Rehabil. 2020 Jun;42(13):1880-1885. doi: 10.1080/09638288.2018.1542460
8. Martin-Saez MM, James N. The experience of occupational identity disruption post stroke: a systematic review and meta-ethnography. Disabil Rehabil. 2021 Apr;43(8):1044-1055, doi: 10.1080/09638288.2019.1645889
9. Persson HC, Danielsson A, S Sunnerhagen K. A cross sectional study of upper extremity strength ten days after a stroke; relationship between patient-reported and objective measures. BMC Neurol 2015;15:178, doi: 10.1186/s12883-015-0436-8
10. Narai E, Hagino H, Komatsu T, Togo F. Accelerometer-based monitoring of upper limb movement in older adults with acute and subacute stroke. J Geriatr Phys Ther. 2016 Oct-Dec;39(4):171-7.
11. Shapira-Vadler O, Treger I, Katz-Leurer M. Muscle strength, function and heart autonomic regulation system recovery at the sub-acute stage post stroke. Eur Neurol. 2015;74(3-4):154-157, doi: 10.1159/000440953
12. Yun GJ, Chun MH, Kim BR. The effects of transcranial direct-current stimulation on cognition in stroke patients. J Stroke 2015;17(3):354-8.
13. Zavaglia M, Forkert ND, Cheng B, et al. Mapping causal functional contributions derived from the clinical assessment of brain damage after stroke. Neuroimage Clin. 2015;9:83-94, doi: 10.1016/j.nicl.2015.07.009
14. Mohaghegh S, Hajian M. Stroke in a young swimmer. Asian J Sports Med 2015;6(2):23812-18.
15. Song J, Ma Z, Huan M, et al. Distal hyperintense vessels alleviate insula infarction in proximal middle cerebral artery occlusion. Int J Neurosci 2016 Nov;126(11):1030-5, doi: 10.3109/00207454.2015.1102139.
16. Dean JC, Kautz SA. Foot placement control and gait instability among people with stroke. J Rehabil Res Dev. 2015,52 (5): 577-90.
17. Lim JS, Kang DW. Stroke connectome and its implications for cognitive and behavioral sequela of stroke. J Stroke. 2015;17(3):256-67, doi: 10.5853/jos.2015.17.3.256.
18. Ghosh S, Das SK, Nath T, et al. The effect of citicoline on stroke: A comparative study from the Eastern part of India. Neurol India, 2015;63(5):697-701, doi: 10.4103/0028-3886.166538.
19. Aprile D, DiStasio E, Rominetti F, et al. Effects of rehabilitation on quality of life in patients with chronic stroke. Brain Injury 2008;22(6): 451-456.
20. Bugajski M, Czernicki J. Ocena wpływu ćwiczeń na platformie balansowej z wykorzystaniem biologicznego sprzężenia zwrotnego na reedukację chodu osób po udarze mózgu. CEJSH. 2013;4:439-447.
21. Fedak D, Latała B, Otfinowski J, Zajdel K. Ocena wpływu fizjoterapii na równowagę w pozycji stojącej w grupie pacjentów po udarze mózgu określona na podstawie badań posturograficznych. Acta Bio-Optica et InformaticaMedica. 2010;16(3):208-211.
22. Galasińska K, Buchalski P, Gajewska E. Zastosowanie koncepcji PNF w rehabilitacji pacjentów po udarze mózgu. Nowiny Lek. 2011;80(2):126-133.
23. Janota B, Janota J, Lisiecki G, et al. Rehabilitacja chorych po udarze mózgu w warunkach domowych. Rehabilitacja 2013;11(2):26-30.
24. Krukowska J. Wpływ obciążania kończyn dolnych na równowagę (stabilność) ciała i sprawność chodu osób po niedokrwiennym udarze mózgu. Balneol Pol. 2009;1-3:25-34.
25. Kuliński W. Metody stosowane w fizjoterapii. In: Kuliński W, Zeman K (eds). Fizjoterapia w pediatrii. Warszawa: Wydawnictwo Lekarskie PZWL. 2011, pp. 314-359.

ORCID and contributionship:

Włodzisław Kuliński: 0000-0002-6419-4030 [A, B, D, E, F]
Anna Pasieka: [B, C, D, E]

CORRESPONDING AUTHOR

Włodzisław Kuliński
ul. K Miarki 11B,
01-496 Warsaw, Poland
tel: +48503486095
e-mail: wkulinski52@hotmail.com

A - Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis,
D – Writing the article, **E** – Critical review, **F** – Final approval of the article