POSSIBILITIES FOR INFLUENCE OF KINESITHERAPY OYER THE MOTOR DEFICIT IN PATIENTS WITH DIABETIC POLYNEUROPATHY

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Abstract.. To evaluate the effect from the created by us kinesitherapeutic program over motor deficit in patients with diabetic polyneuropathy (DPN). We have studied 124 patients divided into two groups. The experimental group includes 90 patients and the control group consists of 34 patients. All patients underwent 10-day medical treatment and kinesitherapy. We have applied for the experimental group specialized kinesitherapeutic methods lasting 6 months and the control patients underwent the usual 10-day kinesitherapy. The applied specialized kinesitherapeutic methods (SKTM) improve substantially the motor functions in the lower limbs, stabilize balance and increase the maximum walking speed. The control group faces slight changes in motor deficit. The motor control is a complex process which at patients suffering from diabetic polyneuropathy requires the inclusion of strength exercises, postisometric relaxation, proprioceptive nervous and muscular facilitation, balance and coordination exercises at fulfilled requirements for application at diabetic patients with sensory impairments.
Key words: muscle strength, balance possibilities, gait

The motor neurons, which have been myelinized and which conduct fast nervous tissues, are engaged at diabetic polyneuropathy. The motor disturbances are developed later than the sensory ones despite the fact that the Achilles' tendon reflex is often missing yet when diagnosing the disease [12].

We observe not only subclinical disturbances of motor nerves established through electroneuromyography but also clinical manifestations like muscle weakness in the extremities and mostly in the distal parts of the lower extremities. The extensors and the flexors of the knee and ankle joints have been affected which damages the patients' walking pattern. The weakness and atrophy of adjoining muscles changes the normal values of foot bio-mechanic indicators, leading to plantar pressure, foot ulcers and gait disturbance [2].

The abnormal bio-mechanic factors of balance (gravity center, gravitation line, support area and stability limits) are as a result of the muscular weakness in the distal parts of lower limbs, the reduced movement in the ankle joint and the pain. The posture stability depends also on the coordination of movements in the lower limbs and the ankle joint is a very important factor for the physiological muscular-skeleton control [6].

By the help of kinesitherapy, we can correct the muscle lack of balance at many diseases but its influence over patients suffering from diabetic polyneuropathy has not been sufficiently explored.

Hereby, we set the goal to evaluate the effect of our kinesitherapeutic program over motor deficit in patients with diabetic polyneuropathy.

METHODS

We have studied 124 patients suffering from diabetic polyneuropathy and diabetes mellitus type 2, divided into two groups. The experimental group includes 90 patients (52 women and 38 men, average age 58.47+-8.69 years) and the control group consists of 34 patients (16 women and 18 men, average age 58.79+-7.49 years).

For the purposes of this research, we have evaluated four times (at the beginning of medical treatment, on the 10-th day, on the 6-th week and during the 6-th month after it) the girt of calves [8] and the movement velocity of the knee and ankle joint from the sitting position with the feet not touching the floor (we report in seconds the time for realizing 20 repetitions to flexion and extension at maximal speed of performance and in maximum volume of movement). We have also conducted manual muscle testing of dorsal flexors by a standard method [3]. We have studied changes in the balance abilities through

Romberg's test [5] and through Duncan's test [4]. The gait has been assessed by reporting the cadence and speed of movement when passing a distance of 8 meters [9].

All patients participated in this research have been treated in the neurological clinic of Military Medical Academy-Sofia with alpha lipoic acid (600 mg Thiogamma daily through venous infusion for 10 days) and underwent kinesitherapy sessions. The patients from the experimental group were included in a specialized 6-month kinesitherapeutic program after a given written informed consent for long-term performance of therapeutic exercises at home. The specialized kinesitherapeutic procedure lasts 45 minutes and has moderate intensity [7].

RESULTS

We assessed the following parameters: manual muscular testing, circumference of the calves, the flexion and extension of ankle and knee joint. The objective changes in muscle strength, muscle mass and the mobility of lower limbs are given in table 1.

Table 1 Changes in the muscle strength, the girt of calves and mobility of ankle and knee joint

*** p<0.001, ** p<0.01, * p<0.05 - considerable differences for each group in the course of treatment with respect to initial values; p-considerable differences between the experimental group (EG) and the control group (CG).

Parameter	Group	Beginning	On the 10-th day	On the 6-th week	On the 6 month
		$\bar{X}\pm S_D$	$\bar{X}\pm S_D$	$\bar{X}\pm S_D$	$\bar{X}\pm S_D$
Manual muscular testing of dorsal flexors (degrees)	EG	4.58±0.50	4.82±0.38***	4.96±0.21***	5.00±0.00***
	CG	4.74±0.45	4.74±0.45	4.62±0.49*	4.53±0.51*
	p	0.108	0.283	**0.001**	**0.001**
Girt of the calves (cm)	EG	37.60±2.51	38.03±2.52***	38.50±2.46***	38.52±2.20***
	CG	39.51±1.83	39.46±1.96	39.35±2.05	38.53±2.09***
	p	**0.001**	**0.004**	0.075	0.466
Speed of movements in the knee joint (s)	EG	22.00±2.70	18.51±2.57***	16.84±2.56***	17.78±2.76***
	CG	21.76±6.60	20.94±5.67	22.00±7.04	25.35±3.26***
	p	0.778	**0.001**	**0.001**	**0.001**
Speed of movements in the ankle joint (s)	EG	19.84±4.04	15.84±3.36***	14.56±3.34***	15.00±3.06***
	CG	18.97±4.76	19.21±3.41	19.88±3.00**	22.65±2.77***
	p	0.355	**0.001**	**0.001**	**0.001**

The strength of the dorsal flexors at the left and right leg before the treatment does not show considerable differences between the two groups. All parameters for muscular strength are considerably improved at the experimental group after the 10-th day unlike control patients where the changes are minimal but with a trend for deterioration especially emphasized after the 6-th week from the beginning of treatment. After the application of SKTM the power of dorsal flexors increased as in the end of the period all patients from the experimental group with a deviation at the initial study (42.2%), reach a degree of full restoration - grade 5.00 from the manual muscular testing.

When comparing the girt of the calves, we establish that the patients from the control group have much higher absolute values. At the end of the kinesitherapeutic course, we report an increase in the muscular mass of the calves at the experimental group and a decrease - at the control patients as the absolute values get even.

We observe at both groups a difference in the initial duration for performing movements. In the course of treatment at the experimental group, we establish some improvement in the speed of movements, clinically expressed into shortening the time of flexion and extension in the ankle and knee joint, while at control patients the time is prolonged.

The results from static balance (Romberg's test and Duncan's test) and the gait (by determining cadence and the maximum speed for passing 8 meters) are presented in the table 2.

Table 2 Changes in static ataxia and gait parameters

Parameters	Group	Beginning	On the 10 day	On the 6-th week	On the 6-th month

		$x \pm s_D$	$X \pm S_D$	$x \pm s_D$	$X \pm S_D$
Romberg's test (s)	EG	15.58±10.35	28.31±16.42***	36.67±18.71***	40.13±19.47***
	CG	19.18± 12.70	19.06± 12.05	16.82±11.14	14.85± 10.6
	P	0.550	0.002	**0.001**	**0.001**
Duncan's test (cm)	EG	20.30±7.13	30.50±8.09	32.45±7.12	30.68±7.72
	CG	28.69± 10.19	29.94±6.66	28.37±6.90	24.97±7.23
	P	0.067	0.494	**0.001**	**0.001**
Cadence for 8 m of walking (usual gait)	EG	17.40±3.26	16.04±3.02***	15.16±3.11***	15.57±3.69***
	CG	I6.35±2.42	16.47±2.53	17.24+1.95***	18.91±2.02***
	P	0.091	0.466	**0.001**	**0.001**
Maximum speed for passing 8 m (cm/s)	EG	107.38+30.93	130.02±32.34***	139.09±26.47***	133.99±28.28***
	CG	104.91 ±33.89	99.69±25.82	96.65±24.46	85.55+8.53**
	P	0.701	**0.001**	**0.001**	**0.001**

*** p<0.00l, ** p<0.01 - considerable differences for each group in the course of treatment in comparison with the initial values; p-considerable differences between the experimental group (EG) and the control group(CG).

After the applied specialized kinesitherapeutic methods the balance stability gets improved substantially. On the 6-th month, the patients remain stable for a long time (with 24.55 seconds, p<0.001) at Romberg's test and reach a longer distance (with 12.38 cm, p<0.001) according to Duncan's test. We did not establish at control patients positive changes during the whole period of the course of treatment.

The specialized kinesitherapeutic methods increase substantially the maximum gait speed and reduce cadence at the usual speed of movement most vividly expressed on the 6-th week of our survey (cadence is reduced by 2.24, the movement speed is increased by 31.7 cm/s). We established at control patients a considerable delay in the gait which gets compensated with a larger number and shorter steps for passing the 8-meter distance. The considerable differences between the groups on the 6-th week and on the 6-th month for cadence and after the 10-th day for the movement speed are associated with the opposite trend of changes at the two groups especially emphasized at the end of the treatment period.

DISCUSSION

The presented results show that the applied experimental SKTM improves muscular strength, muscle mass and the movement speed of lower limbs unlike control group of patients, which has been confirmed by the considerable differences between the two groups.

These favorable influences of specialized kinesithereapeutic methods are associated with prevalent exercises against dosed resistance and with meeting the requirements in our methods for their application: at least 8-10 exercises for the main muscular groups with a number of repetitions 8-12 times at the gradual increase of loading and accuracy of performance. The power exercises with the given resistance through elastic Thera-Band, applied in experimental group provide an opportunity for prolonged daily application [1].

The established by us positive results when studying the speed for performing movements in ankle and knee joint, besides with the increased muscular force, are also associated with overcoming the muscle lack of balance at lower extremities as a result of the used selective approach when choosing kinesitherapeutic means based on bio-mechanic changes with patients with diabetic polyneuropathy. The included in experimental methods from proprioceptive nervous and muscular facilitation for muscle relaxation with increased muscular tone (a long muscle flexor of toes, plantar flexors and ischiocrural muscles) lead to accelerating the speed for performing movements in the ankle and knee joint. It is well-known that the improvement of strength in ankle muscles is of great importance for overcoming muscular hypotrophy and when synchronizing the muscular activity in patients with peripheral neuropathy. Meanwhile, the improved coordination associated with positive reflex changes, increases mobility and the opportunities for more obvious increase of muscle power [9].

The observed improvement in balance and of gait performance is due to the long application of the exercises for coordination and balance without visual control in experimental methods. The expediency of their application is proved by the fact that the main reason for this disturbance is the damaged proprioreception with patients with diabetic polyneuropathy, which is mainly compensated with visual control and spatial orientation of lower extremities. The used in our program therapeutic exercises are based on the usual recommendations for kinesitherapeutic influence of sensory ataxia at neuropathy by

excluding visual analyzer when standing on a firm support and coordination movements with and without visual control.

It is probably of great importance for the positive effect of SKTM also the incorporation of stretching techniques (postisometric relaxation) for which was established that they lead to an improvement in balance through a positive influence over the proprioceptive threshold of ankle joints [11].

In order to provide a greater stability at walking, besides the improvement of proprioreception, muscular strength and the mobility of lower limbs, it is necessary to include exercises for improving bio-mechanic control, which are missing in control methods - walking with a change in support areas, gravitation line and change of direction, performed with and without visual control. They influence the major bio-mechanic factors of balance at fulfilled requirements for patients with diabetic poly neuropathy with regard to the slow or moderate pace of walking and the use of orthopedic soles [10].

The motor control is a complex process with the participation of different structures of the central and peripheral nervous system, nervous-muscular and bone apparatus, which require an expedient diagnostic and therapeutic approach for their completion restoration in patients with diabetic poly neuropathy with the inclusion of resistance exercises with Thera-Band, postisometric relaxation, proprioceptive nervous and muscular facilitation, balance and coordination exercise with and without visual control at fulfilled requirements for application in cases of diabetic patients with sensory disturbances.

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