

## The effects of physical therapy on exaggerated muscle tonicity, balance and quality of life on hemiparetic patients due to stroke

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### Abstract

**Objective:** To determine the effects of physical therapy on balance, exaggerated muscle tonicity and quality of life on patients with hemiparesis.

**Methods:** This quasi-experimental study was conducted in 2011 among male hemiparetic patients secondary to stroke, at a physiotherapy centre in Neyshabur, Iran. Twenty-four patients were randomly assigned to two equal groups representing the cases and the controls. The cases were assigned to do the practical protocol for 4 weeks. To collect the data, Berg Balance Scaling, Modified Ashworth Scale, Barthel Activities of Daily Living Index and demographic questionnaires were used. Paired and un-paired t-tests were used to analyse data. All analyses were done on SPSS 16.

**Results:** The two groups were similar before intervention. Post-test analysis showed that the average balance and quality of life significantly improved ( $p < 0.001$ ) among the cases, and the quadriceps muscle tonicity decreased ( $p < 0.001$ ). Among the controls, there was no significant change between pre-test and post-test readings.

**Conclusions:** Physical therapy can enhance balance and quality of life of hemiparetic patients and reduces their exaggerated muscle tonicity.

**Keywords:** Hemiparesis, Physical therapy, Quality of life, Muscle tonicity. (JPMA 63: 735; 2013)

### Introduction

Hemiparesis, or unilateral weakness of the body, most commonly results from stroke in humans.<sup>1</sup> In most cases, the major causes are the corticospinal pathway involvement, and the diseases damaging the motor centres or causing disorders in the brain. Stroke is one of the major causes of death and disability in almost all communities.<sup>2</sup> After the heart diseases and cancer, it is also the third leading cause of death and the most common cause of disability in adults.<sup>3</sup> About 30 to 40 per cent of people who survive a stroke, suffer from some severe disability.<sup>4</sup>

Although the intensity and variety of disorders in hemiparetic patients are related to the location and extent of the lesion, motor dysfunction remains its major clinical sign.<sup>5</sup> A variety of therapeutic interventions have been explored in several studies for patients with hemiparesis, including stretching exercises, balance and

coordination,<sup>6,7</sup> functional mobility and massage,<sup>8,9</sup> strength training (isometric, isotonic, isokinetic),<sup>10</sup> aerobics,<sup>11</sup> gait training, treadmill training and stepping exercises.<sup>12,13</sup> The primary goal of physical therapy in these patients is to enable them to perform daily activities independently and to remove disease-related symptoms. Exercise is one of the few treatments which is accessible and has no side effects. Although many studies were conducted to find the effects of various methods of physical therapy on decreasing aggravated muscle tonicity and improving balance and walking indexes,<sup>14-17</sup> but there is no consensus on common methods of physical therapy in the treatment of the disorders associated with hemiparesis secondary to stroke, especially in the chronic stage. The aim of this study was to consider the effect of 4 weeks of physical therapy on male hemiparetic patients.

### Patients and Methods

The quasi-experimental study was conducted in 2011 and included all male patients referred to Mohammed Ali Fayaz Bakhsh Physiotherapy Centre in Neyshabur city, Iran. The subjects had a stroke at least a year before the study, were aged between 40 and 60 years, had been diagnosed with hemiparesis secondary to stroke, had the ability to stand feet apart with open eyes for at least 30 seconds, could understand the instructions, had the ability to change direction, and were not part of any out-

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of-study rehabilitation programme during the study period. The inclusion criteria was met by 24 patients and they were randomly divided into two equal groups as cases and controls. Informed written consent was obtained from all participants, and the study was approved by the Research Ethics Committee of Ferdowsi University of Mashhad, Mashhad, Iran.

Static and dynamic balances in subjects were evaluated using the Berg Balance Scale (BBS).<sup>1</sup> This scale includes 14 items related to routine daily activities, and each item is evaluated on a five-degree scale, ranging from zero to four, based on the level of function and duration to complete an exercise.<sup>2,10</sup> The Modified Ashworth Scale (MAS) was used to measure the intensified tonicity of quadriceps muscle.<sup>18</sup> At this scale, the muscular tonicity is estimated by considering the muscles at resting, touching the abdominal muscles, muscular resistance against stretching and passive movements. The reliability of this scale within group had been reported to be 0.86 and between groups to be 0.75.<sup>19</sup>

Barthel Activities of Daily Living (ADL) Index was used to assess performance in basic everyday living. This scale includes 10 items of basic activities that a person does during the day. The maximum score of the scale is 100. The internal reliability of this scale in different studies has been reported to be 0.98.<sup>20</sup>

The physical therapy programme was designed and performed, including a combination of 25 different therapeutic exercises, joint mobility, 17 types of balance exercises, 5 types of isotonic strength trainings for treatment of the disorder and it was based on theoretical principles related to motor control, motor learning, control and status to develop and strengthen the muscle. The selected physical treatment protocol

used in the study was confirmed by a neurologist. The experimental protocol training was conducted for 4 weeks; three one-hour sessions every week. After 5 minutes of warming up through walking on a flat surface, the patients did the mobility and movement exercises of the hip joints, knees, ankles, and a series of general mobility exercises, balance exercises, strength training and flexor, extensor and abductor of hip, flexor and extensor of knee, repeating 10 times.

SPSS 16 was used for statistical analysis. Paired t-test was used to compare the pre- and post-test results of each group, and un-paired t- test for comparing the results of the two groups. Normal distribution of data was evaluated by Kolmogorov-Smirnov test. Levin test was also used for homogeneity of variance. The confidence level of significance was considered to be more than 95%.

## Results

The average age of the patients was 53.33±5.19 years; 52.41±5.46 years for the controls, and 54.25±4.97 years for the cases (Table-1).

The two groups were not significantly different from each other in terms of balance, muscle tonicity and quality of

Table-1: Demographics.

Variable	Control Group (Mean ± SD)*	Experimental Group (Mean ± SD)*	p-value**
Age (year)	52.41±5.46	54.25±4.97	<0.942
Weight (kg)	74.25±5.75	73.66±5.49	<0.899
Height (cm)	170.75±3.3	171.25±3.04	<0.805
Time (months)***	30.91±12.66	31.5±11.85	<0.903

\*SD: Standard Deviation

\*\*Un-paired t-test

\*\*\*The time elapsed from stroke.

Table-2: The Comparison of pre- and post-test measurements.

Variable		Pre- test (Mean ± SD)*	Post- test (Mean ± SD)*	p-value**
Balance	Control Group	33.20±3.70	32.0±4.08	<0.119
	Experimental Group	33.00±3.10	47.33±4.11	<0.001
	p-value***	<0.500	<0.001	<0.279
Muscle Tonicity	Control Group	2.90±0.56	3.20±0.63	
	Experimental Group	3.25±0.62	1.16±0.83	<0.001
	p-value***	<0.534	<0.001	
Quality of Life	Control Group	58.00±6.74	55.00±6.23	<0.111
	Experimental Group	56.66±10.73	85.00±9.04	<0.001
	p-value ***	<0.915	<0.001	

\* SD: Standard Deviation

\*\* Paired t-test

\*\*\* Un-paired t-test.

life in pre-test evaluation. After implementing the programme on the cases, a significant difference ( $p < 0.001$ ) was seen between the average of all the three factors in the two groups (Table-2).

The level of balance improved by 43.42% and the level of activities of daily living by 50%, but the muscle tonicity decreased by 64% ( $p < 0.001$ ) among the cases. In the control group, no significant difference was found between pre-test and post-test measurements.

## Discussion

After one month of training, scores on the two motor function indexes — BBS and MTS — as well as on the ADL index changed significantly.

A group of researchers studied the effect of walking exercise on motor cortex excitability changes in stroke patients and they found improvement of balance.<sup>21</sup> Others found that the balance of upper body part would improve following Reaching Movements Training.<sup>22</sup> Still others reported the improved balance after balance training in patients with hemiparesis but capable to walk.<sup>15</sup> One study concluded that treatment protocols can improve and increase balance in hemiparetic patients.<sup>23</sup> A study on the effect of mutual and bilateral whole-body practice on balance and gait of stroke patients observed that these exercises increase the balance of these patients.<sup>24</sup> These findings are consistent with the results of our study. It seems that regardless of the type of practice, it is effective on brain motor cortex excitability, stimulation of deep receptors and coordination between visual information, proprioceptive information and processing of these information in the brain stem and cerebellum; and can improve balance.

The effects of strength training on exaggerated muscle tonicity have been reported in patients with chronic hemiparesis secondary to stroke.<sup>14</sup> The study reported that the decrease in tonicity may be due to training and re-organisation of the central nervous system (changes in synaptic efficiency and muscle structure organisation).

The incompatibility of our results with findings of certain studies may be due to the difference in methods of research, study variables such as number of sessions, model of training programmes, exercise and repeat numbers of exercise protocol in one session, elapsed time from the disease secondary to stroke, and even the stroke severity of subjects in the study.<sup>16</sup> Subjects suffering from mild and moderate to high intensities of hemiparesis secondary to stroke will not respond equally to the physical therapy and exercise.<sup>14</sup> Another limitation in the study could be the different medicines with different

doses for patients with hemiparesis which may change the results.

A significant increase (50%) in ADL terms in the experimental group means that they were able to perform some daily activities independently or with minimal support that previously they could not do.

Improvement in balance due to the chosen physical therapy can reduce fall, increase the coordination of activities, reduce inactivity and improve the overall quality of life in patients with hemiparesis secondary to stroke. These results are consistent with earlier studies about the disorders of motor function in patients with hemiparesis, and the effect of Functional, Balance and Strength (FBS) exercise protocol in the treatment of these disorders.<sup>23</sup> They were also consistent with a study about the effectiveness of high-intensity resistance training on muscle strength and performance, and long-term disabilities of stroke patients.<sup>12</sup> Along with improving balance and reducing muscle tonicity, it seems that ADL also improves in these patients.

## Conclusion

Physical therapy improved balance and quality of life of patients with hemiparesis and reduced their muscle tonicity. Physicians and physiotherapists should use these exercises for patients with hemiparesis secondary to stroke, because they do not require expensive equipment and are easily accessible.

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