DOI: https://doi.org/10.53350/pjmhs22163529

ORIGINAL ARTICLE

The Effect of Sensorimotor Exercises on Hand Mobility in Patients with Cerebral Palsy Hemiplegia Half of the Body

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ABSTRACT

Background and Aim: Cerebral palsy is a very common sensory-motor disorders that can lead to functional hand disabilities and reduced participation; therefore, the aim of the present study was to investigate the effect of sensorimotor training on the motor ability of patients with cerebral palsy. Methods: In the present quasi-experimental study, the statistical population included all patients with cerebral palsy in Tabriz rehabilitation centers. 30 male and female hemiplegia patients aged 45 to 70 years were selected as the available sample and randomly divided into two groups of 15 test and control. Box and block tests were used to measure gross motor ability. The training program included the sensory and motor part, which was done for eight weeks and 3 sessions per week and 60 minutes per session. Statistical analysis of data was performed using SPSS software version 26. Independent and paired t-tests were used at a significance level of 0.05. Results: The results of the present study showed that after the application of simultaneous sensorimotor exercises, the motor function of the upper limb was significantly improved ($p = 0.000$). The mean change was observed in the experimental group from 9.12 ± 1.16 to 13.05 ± 2.56 and in the control group from 8.92 ± 1.27 to 9.02 ± 0.94. Conclusion: Using simultaneous sensorimotor exercises can lead to improved hand mobility if sensory-motor experiences are created. Therefore, this type of exercise can be used in the rehabilitation program of patients with cerebral palsy according to their needs. 53% of the changes in depression and 57% of the changes in anxiety were due to neurofeedback; but neurofeedback had no effect on stress. Neurofeedback was able to reduce depression and anxiety in women with abdominal pain but had no effect on their stress level.

Keywords: Sensory motor exercises, motor ability, cerebral palsy, hemiplegia

INTRODUCTION

Cerebral palsy is a very common sensory-motor disorder caused by damage to the central nervous system, which is associated with disability and impaired movement and condition of the body organs. The prevalence of this disability is approximately 2 per 1,000 live births (1). Hemiplegia is one of the most common types of cerebral palsy in individuals and the second most common type in premature infants, which accounts for 36% of all cerebral palsy (2). The resulting motor injuries are mostly unilateral, and upper limb defects are a very common disorder that results from cerebral palsy. These disorders affect and limit the function of the affected upper limb (3). Patients with cerebral palsy have impaired many manual skills and motor functions compared to their normal peers due to a lack of proper sensory experience and poor mobility imposed on them, which reduces control of upper limb movements in the development of protective reactions. Maintaining the alignment of the joints in bearing weight reduces the strength of the affected hand and ultimately leads the patient to remove the injured side and find it difficult to participate in educational and social functions and activities of daily living (4). Numerous studies have shown that there are varying degrees of sensorimotor disorders in patients with cerebral palsy and a very close relationship is observed between sensorimotor components and functional performance. Mohammadi et al. (5) investigated the effect of superficial and deep sensory stimuli on the dexterity of Down syndrome patients. They found that it was better to use a variety of sensory stimuli to improve the hand skills of patients with Down syndrome and possibly other patients with upper extremity dysfunction due to impaired motor control. Azad et al. (6) investigated the effect of sensory retraining on improving upper limb function in stroke patients. The findings showed that four of the five patients studied showed significant improvement in motor disabilities as well as upper limb skills and function. In a study, Carey et al. (7) Studied the effect of tactile and profound rehabilitation on four stroke patients in the acute phase of the disease. They found a significant improvement in the sensory function of the studied patients, which was maintained for months after the intervention; But no attempt was made to assess patients' motor improvement. Smania et al. (8) investigated the effect of somatosensory rehabilitation and related motor evidence deficits in stroke patients. The results of their study showed that this program leads to the improvement of profundity defects and motor evidence defects, as well as some functional improvements in these patients.

Therefore, it can be stated that the results of these studies only consider the use of sensory exercises to be effective in improving the motor function of the upper limb; While motor exercises can play a stimulating role for the nervous system. Motor deficiency due to sensorimotor injuries in patients with cerebral palsy, causes poor coordination of movements and impairment and damage to their functions, and ultimately has a negative impact on their entire bodily function (3). Therefore, in the present study, the use of sensory and motor exercises was used simultaneously; Therefore, due to the sensory-motor defects that have been imposed on these patients and functional disorders due to sensorimotor injuries due to lack of sensory stimulation and lack of proper motor control in hemiplegia patients and the effect it has on their quality of life, The aim of this study was to investigate the effect of sensorimotor exercises on the motor ability of patients with cerebral palsy.

MATERIAL AND METHOD

In the present quasi-experimental study, among cerebral palsy patients in Tabriz Rehabilitation Centers, 30 hemiplegic patients, 45 to 70 years old, were available by sampling method from people with entry conditions, after receiving permission from the authorities and written consent from the families of the subjects. , Were selected to implement the plan. The samples were then randomly divided into two groups of 15 test and control. The experimental group performed simultaneous sensorimotor exercises and the control group performed only their usual exercises and programs in rehabilitation centers. Inclusion criteria included diagnosis of hemiplegic cerebral palsy by a specialist physician and placement at levels 1 and 2 on manual ability classification system. The system categorizes in five levels how cerebral palsy patients use their hands to control objects in daily life, and the higher the level, the poorer the performance. Its levels are in the following order.

1 The person controls objects easily and successfully. 2. The person controls most of the objects; But to some extent the quality

and speed of completion of the activity decreases. 3. The person has difficulty controlling objects and needs help to prepare or modify activities. 4. A person can only do very simple tasks that either the situation is prepared in advance or aids are used to perform the activity. 5. The person is not able to control objects and has little ability to do very simple tasks.

Reliability between testers for this test is 0.97 and reliability between family and therapists is 0.96 (9). Other inclusion criteria were spasticity of the elbow and fingers between 0 and 2 based on the modified Ashworth scale. This scale is used manually to determine the resistance of a muscle to passive traction in spasticity assessment.

Classification levels: 0. Do not increase muscle strength. A weak increase in muscle strength when bending or opening the affected limb (s), which is characterized by trapping and releasing with minimal resistance at the end of the range of motion. 2. A marked increase in muscle "tone" characterized by entrapment in the midline and continued resistance in the remaining domain; but the member (s) can be moved easily. 3. Significant increase in muscle "tone", inactive movement is difficult to do. 4. Fixed limb (s) in a bent or open position. The reliability of the retest test of this scale for assessing spasticity of the upper limb in patients with a hemisphere injury was reported to be good 0.75 to very good 0.90 (10). Box and block tests were used to measure the motor ability of the hand (11).This test has a wooden box that consists of two parts and 150 cubes are placed on one side. This test is paired with time and the test method is that the test is performed in one minute and the number of displaced cubes is recorded. If a person carries more than one cube in each hand, one number is recorded for her and if the cube falls out of control while moving uncontrollably or is placed outside the designated area, it will not be counted. The greater the number of cubes moved over time, the better the performance of the hand. The reliability of the retest test is 0.976 for the right and 0.937 for the left and the reliability between the expensive test is 1.000 for the right and 0.999 for the left (12-14). The training program consisted of three parts: sensory (tactile and deep) and motor (15).The duration of this intervention was eight weeks (three one-hour sessions per week), of which 10 minutes for warm-up, 45 minutes for sensory-motor exercises, and 5 minutes for cooling. Of the 45 minutes of sensory-motor training, each of the tactile, deep, and motor exercises accounted for 15 minutes, or one-third of the time per session. In each training session, 30 minutes were dedicated to superficial and deep sense exercises and 15 minutes were related to movement exercises. Move and engage your hands. Before each exercise, the method of doing it was shown orally and practically, and people became familiar with the exercises. Exercises include the sensory part, which includes activities related to sponge exercises, finger painting, walking, and the movement part, which includes activities related to throwing and catching the ball, purposeful throwing the ball, moving the ball between the two hands, and hitting the ball. It was hitting the ball to the ground and hitting the ball against the wall and catching it.

Shapiro-Wilk test was used to show the normality of the data. Then, paired t-test was used for intragroup comparison between pre-test and post-test variables and independent t-test was used for intergroup comparison of post-test variables. Also, SPSS software version 26 was used for statistical operations.

RESULT

A summary of the individual characteristics of the subjects is provided in Table 1. The mean age of the experimental group was 59.93 ± 2.08 and the control group was 60.14 ± 1.77, the mean height of the experimental group was 168.56 ± 6.47 and the control group was 170.09 ± 7.22 and the mean weight of the experimental group was 74.04 ± 7.03 and the control group was 76.17 ± 6.83.

Tables 2 and 3 show the mean and standard deviation before and after training, motor ability as well as the results of independent and paired t-test. Eight weeks of sensorimotor training led to a significant effect on the ability of motor ability in the experimental group (P <0.05, t = 6.645), no significant results were observed in the control group (P <0.05, t = -0.393). Overall, a significant difference was observed between the control and experimental groups (P <0.05, t = -5.708), which indicated the significant effect of simultaneous shallow and deep sense exercises and movement exercises on the motor ability of patients with cerebral palsy. Therefore, the research hypothesis was confirmed.

Table 1: Demographic characteristics of the subjects (n = 30)

Sig	Standard deviation	Average	group	Variable
0.714	2.08	59.93	Experimental	Age (years)
	1.77	60.14	Control	
0.406	6.47	168.56	Experimental	Height (cm)
	7.22	170.09	Control	
0.388	7.03	74.04	Experimental	Weight (kg)
	6.83	76.17	Control	
0.435	10.69	32.05	Experimental	Time elapsed since stroke (months)
	11.36	30.22	Control	

Information about the motor ability of the subjects in the control and experimental groups are presented in Tables 2 and 3, Figure 1.

Table 2: Results of Independent Samples t-test on Motor ability in control and experimental groups

Variable	Group	M±SD	M±SD Control	t	P
Motor ability	Pre-exam	1.27 ±8.92	1.16 ±9.12	-0.442	0.05> p
	Post-test	0.94 ±9.02	2.56 ±13.05	-5.708	0.01≤p

Table 3: Results of Paired Samples t-test on Motor ability in control and experimental groups

Variable	N	T	DF	Sig	Percentage
Daily activity (control group)	15	-0.393	14	0.700	1.1%
Sensory motor exercises (experimental group)	15	-6.645	14	0.000	43%

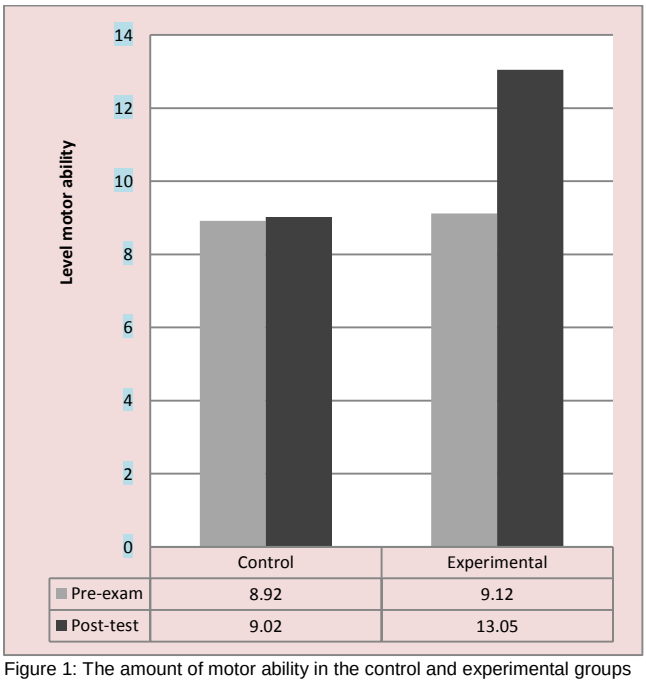

Figure 1: The amount of motor ability in the control and experimental groups

Information about the motor ability of the subjects in the control and experimental groups is presented in Figure 2.

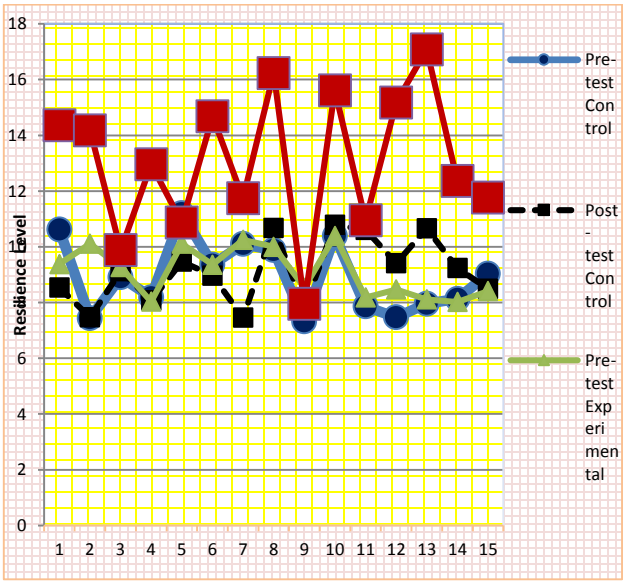

Figure 2: The degree of hand mobility of cerebral palsy patients in the control and experimental groups

DISCUSSION

The results showed that simultaneous deep surface sensation exercises and motor exercises improved the motor ability of patients with cerebral palsy. During a review of related research; It was observed that Mohammadi et al. (5) had studied the effect of superficial and deep sensory stimuli on the dexterity of Down syndrome patients. They showed that in order to improve the dexterity of patients with Down syndrome and possibly other patients with upper extremity dysfunction due to impaired motor control, it is better to use a variety of sensory stimuli. Ahlborg et al. Hunter et al. (17) investigated the effect of mobility and tactile stimulation rehabilitation program on improving upper limb function in stroke patients. The results of the study showed a significant improvement in performance. Also in another study, Azad et al. (6) examined the effect of sensory retraining on improving upper limb function in stroke patients. The results showed that four of the five patients studied showed significant improvement in motor disabilities as well as upper limb skills and function.As it was observed, the methods used in the mentioned researches do not exactly match the method used in the present study or the group of patients; However, a common and very important point of the results of the present study with the mentioned researches is that the use of two categories of sensory exercises and especially stimulation of sensory receptors can have better results on the performance of patients of brain origin; Therefore, in addition to emphasizing the effect of exercises and sensory stimuli, the present findings also focus on motor exercises, and as a result, provide new information about the common use and enhancement of their simultaneous use on the studied individuals. Brain lesions may impair the function of the hand and its components, as well as several functions of the body. The use of the hand requires information about depth, touch, sight and coordinated movements; while sensorimotor disorders in children with cerebral palsy lead to impaired motor skills and functions (18). Theoretically, it can be said that by knowing and being able to direct sensory information and integrate this multiple sensory information to create functional behavior, the transmission of information through sensory receptors in the upper limb can be increased, thus involving more neurons and internal communication. It also improved the network. The motor cortex of the brain receives sensory inputs from all parts of an organ; But most of the sensory inputs transmitted to this area are received from the distal areas of the limbs; Therefore, it is possible to improve the processing dysfunction and sensory integration and consequently the lack of motor evidence in these patients to some extent (19); Therefore, with purposeful and comprehensive sensory stimulation and by creating motor experiences and with more emphasis on simultaneous sensory and motor stimulation can increase the awareness of the cerebral cortex of the upper limb (20). According to the results of this study and other studies that have used only one type of exercise as a training method to improve the ability to perform hands, it seems that the application of two types of simultaneous sensory and motor training methods is the strength of the present study;Therefore, it is possible to increase the transmission of information through the sensory receptors of the upper limb by providing sensory-motor exercises in the form of a comprehensive exercise program, and as a result, more neurons are involved. Following these changes, defects in performance, processing, and integrity improve, leading to motor witness and improved motor skills and performance. Therefore, it can be said that by increasing the information of sensory receptors in the form of a comprehensive exercise program based on sensorimotor exercises by creating experiences and opportunities to improve hand motor function in patients with cerebral palsy hemiplegia, it is better to use this type of combination exercises. Limitations of this study included the age of the subjects (45 to 70 years) and the small number of subjects and gender segregation; therefore, in generalizing the results of this study, caution should be observed and it is better to do a similar study with a larger sample size as well as long-term follow-up in this field. In addition, it is suggested that future studies examine the effect of this treatment on increasing functional independence as well as improving ability in daily life activities.

CONCLUDING

Given the importance of the hand in maintaining individual independence and the development of other skills and the important role of these skills in the individual interacting with the environment, it can be said that the use of sensorimotor exercises can improve hand functions in daily life and increase the independence of these patients. Finally, it is suggested that sensorimotor exercises be used in their hand rehabilitation program according to the needs of these patients.

Thanks and appreciation: The researchers are very grateful to the Tabriz Rehabilitation Centers and all the subjects and their families who allowed this research to be done so that the results would be helpful to other people.

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