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Original article

THE ROLE OF MIRROR THERAPY IN THE IMPROVEMENT OF UPPER LIMB FUNCTION IN POST-STROKE PATIENTS – CASE STUDY

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Abstract

Purpose: Mirror therapy has been introduced as an effective rehabilitation mean after limb amputations. Different researches have also shown positive effects in the functional rehabilitation of the upper limb in post-stroke patients. The aim of this case study paper is to analyze the extent in which integrating mirror therapy sessions in the rehabilitation program of a 56 year old post ischemic stroke patient contributes to the improvement of his upper limb functionality.

Methods: The research methods we used are: the bibliographic research, the observation method and the case study method. For the assessment of the subject's upper limb function we used the Fugl-Meyer test. The study begun in September 2013 and is still in progress. For the paper, we will report to the evolution of the patient by the end of November. In the rehabilitation program we integrated Bobath therapy, PNF therapy and Mirror therapy. The subject was hospitalized for a month and afterwards he continued rehabilitation at home where he underwent a number of 3 rehabilitation sessions per week. Mirror therapy was integrated after the discharge.

Results: So far, the results of the study we are conducting are positive. The patient was assessed at the end of November. We noticed an improvement in the shoulder, elbow, wrist and hand movements as well as an increase in the precision and execution speed.

Conclusions: Mirror therapy is a useful tool for the functional rehabilitation of upper limb in post-stroke patients. The positive results we had so far are enabling us to continue the research and in the end extend it on larger groups of subjects.

Key words: mirror therapy, upper limb, rehabilitation, stroke.

Introduction

Stroke is one of the leading death and disability causes worldwide, though up to 80% of all cases may be prevented by reducing the individual's risc. Stroke incidence differs by region. It is decreasing in Western Europe and North America and has an increasing trend in Eastern Europe and Asia.

There are approximately 16 million new stroke cases each year, causing a total of 5.7 million deaths.

Romania is amongst the first 10 european countries regarding the number of new stroke cases occuring each year, with approximately 200 new cases/100000 inhabitans. According to statistics, in 2010, there were 49305 deaths, from which 6055 affected individuals under 65 years of age (Nichols, et. al., 2012).

Worldwide, 40 to 50% of total deaths amongst young adults are attributed to haemoragic strokes while for a third of the cases the causes are unknown (Love, Biller, 2009).

From the late 1990s, the number of stroke survivors has increased. 50-60% of them have subsequent neuro-motor sequelae which decrease the quality of their life and are a real burden for the national economies (Adamson, et. al, 2004). On average, 0.27% of gross domestic product is spent on stroke by the national health systems (Di Carlo, 2009).

In the EU countries, the total annual cost with stroke is estimated at 38 billion euros. In 2009, Romania had the lowest cost/stroke patient from all the EU countries, respectively 6 euros (Nichols, et al., 2012).

Functional rehabilitation is the main objective of a physical therapy program after stroke. It is very important to have an up to date understanding and approach of the impairment in order to be able to conceive an individualized rehabilitation plan tailored on the specific needs of each patient. It is the only way in which we can contribute to the improvement of the patient's quality of life.

The literature is rich in studies that focus on the optimal functional rehabilitation of post-stroke patients. There have been conducted many comparative studies of different aproaches, all of them aiming to determine which approach is more appropriate (Young, Forster, 2007).

A meta-analysis on the importance of long term post stroke physical therapy (for at least six months after the debut) included 15 studies, on a total of 700 research subjects (Ferarrello, 2010). The results showed an improvement of the gait pattern and an increase of the subjects'ability to perform daily tasks independently.

In another comparative study, the authors analized

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how functional rehabilitatin programs contribute to the improvement of the subject's motor control (Langhorne, et. al., 2009). The selected studies had their limitations, but the authors could draw satisfactory conclusions about the rehabilitation of gait and upper extremity function. Therefore, the most efficient strategies for the upper limb functional rehabilitation seem to be the constraint therapy, the electromyographic biofeedback, the mental imagery and the robot-mediated therapies. Gait patterns can be improved through repetitive tasks, in high intensity rehabilitation sessions.

Mirror therapy consists in creating the illusion of perfect bilateral synchronization. Mirror therapy gives better motor capacity and autonomy scores for tasks involving the upper limb and the acquired results last for 6 months. It has been introduced as an effective rehabilitation mean after limb amputations. Lately, different researches have also shown positive effects in the functional rehabilitation of the upper limb in post-stroke patients (Yavuzer, et. al., 2008, Thieme et. al., 2012).

Through this case study we aim to determine whether mirror therapy can be used as an useful tool in the post stroke functional rehabilitation process of the upper extremity of a 56 years old subject.

In Romania there are no studies regarding the effectiveness of this rather new rehabilitation concept so our scope is to determine whether it can be suitable for other individuals recovering after a stroke.

Methods

The subject is a 56 year old male patient, diagnosed with left hemiplegia secondary to a 6 months old ischemic stroke. From the 16th of September to the 11th of October he was hospitalized in the Department of Rehabilitation of Ilfov Emergency County Hospital in Bucharest where he was submitted to a functional rehabilitation session a day. After discharge, from the 14th of October to present he continued rehabilitation at home three times a week.

The subject has high blood pressure and dyslipidemia and is in treatment with Cerebrolizin, Norvasc 10mg, Crestor, Sintrom and B1 and B6 vitamins.

He was informed about the objectives and the scope of the present study and he accepted freely to participate into the research.

The research methods we used in the study were: the bibliographic research, the case study method, the observation method, the Modofied Ashworth Scale for spasticity and the Fugl-Meyer test for the assessment of the subject's upper limb function. To draw the conclusions of this paper we related to the evolution of the patient by the end of November.

The subject was assessed at hospitalization and discharge as well as at home, on the 29th of November.

The initial assessment was tailored on collecting data about the patient's disability through specific tools such as:

- Patient history form;
- Modified Ashworth Scale for spasticity;
- Fugl Meyer test for the assessment of the upper limb function;
- Postural Assessment Scale for Stroke (PASS) for the assessment of the patient's static and dynamic balance;

The patient's blood pressure was monitored before and after each rehabilitation session.

In accordance with the results of his initial assessment, the rehabilitation plan consisted in analgesic electrotherapy (interference current), ultrasound therapy and individualized physical therapy.

The objectives of the functional rehabilitation program were:

- The improvement of the patient's posture and walking performance;
- The improvement of his static and dynamic balance;
- The improvement of his upper limb function;
- The improvement of the patient's coordination.

The rehabilitation strategy we applied was individualized in order to maximize the patient's functional independence and personal daily routines. It included functional tasks performed from sitting, four point kneeling, kneeling and standing designed to improve the patient's balance skills and upper arm movements, PNF techniques for his upper arm, head and trunk, exercises at the Rocher cage designed for the improvement of the subject's walking pattern and upper arm movements and exercises at the quadriceps bench for the inhibition of the lower limb extensor spasticity.

The upper arm exercises required a minimum of aditional equipment consisting in a Bobath Ball and a towel. Mirror therapy was introduced after the discharge and was not associated with other upper arm rehabilitation strategies.

We asked the patient to perform simple shoulder, elbow, wrist and hand movements with his unaffected limb and to permanently concentrate on the movements while watching the mirror. We also integrated grasping and reaching movements. We used objects with different sizes and textures such as paper sheets, pencils, cilinders and small balls.

In the hospital, the functional rehabilitation program lasted for 4 weeks with a frequency of 5 times per week. One session lasted for 1 hour and a half and included a maximum of 6-8 exercises, according to the patient's physical status and level of fatigue. Each exercise was performed in 1-5 sets of 5-10 repetitions each and had a low to moderate intensity in order to avoid the instalation of neuromuscular fatigue. Rest time in between sets varied from 60 to 120 seconds.

At home, the physical therapy program had a three times a week frequency. We related to the same parameters regarding the effort intensity, number of sets, repetitions and rest time. Mirror therapy had a 30

minutes duration. We continued to monitor the subject's heart rate before and after each rehabilitation session.

The assessment we had at the end of November was tailored on collecting only data about his upper limb function.

Results

For a better understanding of the patient's impairment we collected and systematized the results of the initial assessment in Table 1.

Table 1. Initial assessment results

Variables	Results
Initials	A.N.
Gender	Male
Age (years old)	56
Blood pressure (mmHg)	140/80
Heart rate (bpm)	75
Diagnosis	Left hemiplegia after primary ischemic stroke
Risk factors	High blood pressure, dyslipidemia, sedentary lifestyle, smoking
Family history	No
Modified Ashworth Scale score	1
PASS score – maintaining a posture	14
PASS score – changing a posture	21

From the analysis of the data above results that, at the moment of the initial assessment, the subject's heart rate and blood pressure were normal. He had a history of both modifiable and nonmodifiable stroke risk factors such as: high blood pressure, dyslipidemia, chronic smoking and a sedentary lifestyle.

Regarding the spasticity, we could detect a slight increase of the muscle tone mostly in his lower limb. The patient could easily maintain and change different postures and had a relatively good independent walking function even though he relied on a walking stick for longer distances.

To assess the subject's upper extremity function we used the Fugl Meyer test. The results of the initial, interim (at discharge) and final (at home) assessments are summarized in the table below (see Table 2).

Table 2. Fugl Meyer Assessment for the Upper Extremity results

Variables	Assessment		
	Initial	Interim	Final
Reflex activity	4	4	4
Volitional movement within synergy, without gravitational help	15	15	16
Volitional movement mixing synergies without compensation	3	3	5
Volitional movement with little or no synergy	2	2	3
Wrist	2	4	7
Hand	5	5	12
Coordination/speed	3	3	3
Total motor function upper extremity (…/66)	34	36	50
Sensation	12	12	12
Passive joint movement	22	24	24
Joint pain	20	24	24
Total Fugl Meyer – Upper Extremity (…/126)	88	96	110

From the analysis of the data available in Table 2 we may draw the following conclusions:

- At the initial assessment the motor function of the subject's upper extremity represented 51% of the normal one. He could only partially perform movements such as lifting his hand from the contralateral knee to the ipsilateral ear or putting his hand on his lumbar spine.
- The patient had no sensory deficit in his upper extremity.
- We found a limitation of the shoulder passive internal and external rotation and the movements generated a small degree of pain. The patient also experienced some pain at the passive shoulder flexion and wrist extension.
- The Fugl Meyer Test for the upper extremity had a score of 88 points, which represented approximately 70% of the total one.
- After the 4 weeks of functional rehabilitation in the hospital the subject's upper extremity motor function improved with 3%. We registered an improvement of his wrist function as well as a diminisment of the pain he experienced at different passive movements of the upper limb. All passive movements mentioned above could be performed at full range of motion.
- The interim result of the Fugl Meyer test improved with 6%.

Even though he could perform various movements with his affected upper limb, the subject did not use it for his daily routines.

Discussions

As we stated above, we introduced the mirror therapy after the subject's discharge. In order to obtain conclusive results this was the only functional rehabilitation strategy for the upper limb that we have used at home.

The figure below shows the evolution of the subject's upper limb function at the moment of each assessment (see Fig.1.).

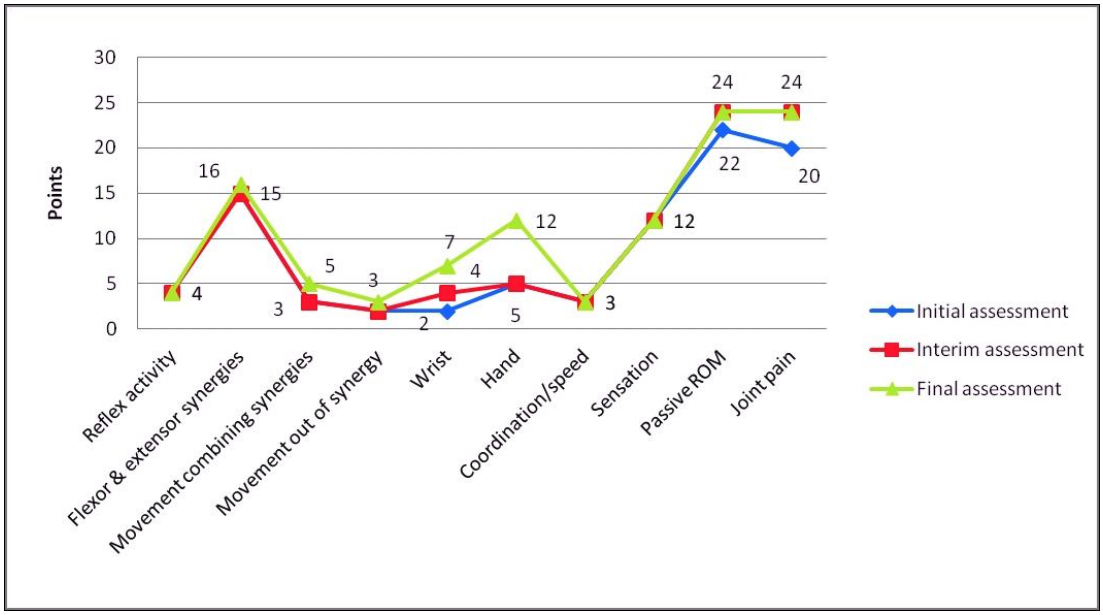

Figure 1. Fugl Meyer Assessment for the Upper Extremity results

At the final assessment we could notice an improvement of the upper extremity overall movements. The total motor function increased with 25%. He could perform complete shoulder flexion from 0^0 to 90^0 with his elbow extended. His supination also improved and was able to do complete pronation-supination movements keeping his elbow in a 90^0 flexion.

The subject found it easier to perform the requested tasks while his precision and movement speed increased with 50%. The greatest improvement was obtained in his hand and wrist movements, therefore his grasping and grabbing skills became more finely honed. For example, the subject was able to hold a cilinder and spherical object against a tug and he managed to hold a pencil. He could perform mass hand flexion and extension at full range of motion and was able to fully dorsiflex his wrist at 15^0 against minimum resistance. We also noticed a diminishment in the upper limb tremor while performing the movements.

After only a month and a half of mirror therapy our subject's upper extremity function improved with 17.3%.

Conclusions

Our case study research revealed positive results. We determined that mirror therapy is a useful tool for the functional rehabilitation of upper limb in post-stroke patients.

The positive results we had so far are enabling us to continue the research and, at some point, extend it on larger groups of subjects.

Unfortunately, at present, it is quite difficult to use it in the hospital due to the lack of materials (mirrors) and the large number of patients needing to be treated simultaneously.

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