

## Review Article

## Stroke Rehabilitation

Esra DH\*

Department of Physiotherapy and Rehabilitation,  
Mustafa Kemal University, Turkey\*Corresponding author: Esra DOGRU HUZMELI,  
Department of Physiotherapy and Rehabilitation, School  
of Physical Therapy and Rehabilitation, Mustafa Kemal  
University, Hatay, TurkeyReceived: November 25, 2016; Accepted: December  
19, 2016; Published: December 20, 2016

## Abstract

Stroke is the second most common cause of death and the leading cause of disability in Europe. Rehabilitation is probably one of the most important phases of recovery for many stroke survivors. There are many different methods in stroke rehabilitation. This review included stroke rehabilitation methods that are used generally in the last decade.

**Keywords:** Stroke rehabilitation; Bobath; Mirror therapy; Telerehabilitation

## Introduction

Stroke is caused when an artery carrying blood from heart to an area in the brain blockage or bleeding thereby preventing delivery of oxygen and nutrients to the brain. Stroke is the second most common cause of death and the leading cause of disability in Europe [1]. The number of survivors from the stroke increased by the improved technology of intensive care units. The numbers of patients with moderate or severe disabilities who are then dependent on others to carry out daily living activities need more rehabilitation and so require more number of rehabilitation team staff [2].

Stroke is an expensive disease. The burden of stroke is considerable in a population and individual level. In a study aimed to quantify the annual cost of illness of stroke to the United Kingdom economy, it was found treatment costs accounting for approximately 5% of total United Kingdom National Health Service costs [2].

Stroke is a complex of motor, sensory, visual and cognitive impairments. So the rehabilitation program should include all the impaired functions. Multidisciplinary stroke rehabilitation is the corner stone of high-quality stroke care. Stroke teams are larger than many health care teams because stroke is a complex disease [3]. Nurse, physiotherapist, occupational therapist, speech-language pathologists, neurologist, neurosurgeon that are specialized in stroke should be in the rehabilitation team.

Rehabilitation is one of the most important phases of recovery for many stroke survivors. Rehabilitation begins in the acute-care hospital after the person's vital conditions stabilized and continues a lifetime. There are many different methods for stroke rehabilitation. Neurodevelopmental Therapy, Mirror Therapy, Neuromuscular Electrical Stimulation, Tele-Rehabilitation, Hydrotherapy, Constraint-Induced Movement Therapy are the most popular methods. We conducted a literature review of rehabilitation interventions on stroke patients.

## Neurodevelopmental treatment

Neurodevelopmental Treatment (NDT) is a rehabilitation approach that is designed according to the International Classification of Functioning Disability and Health and used in the care of stroke patients for last 50 years. NDT or Bobath is a problem-solving approach to the assessment and treatment of individuals with impaired of function, movement, and postural control due to a lesion

of the central nervous system. Bobath aims to reduce spasticity and synergies by using inhibitory postures and movements in order to facilitate normal autonomic responses [4].

Despite popular of clinical use, its effectiveness is questionable. Paci examined "whether there was evidence to accept neurodevelopmental treatment as an effective approach. A systematic literature search was undertaken and results show no evidence proving the effectiveness of neurodevelopmental treatment or supporting neurodevelopmental treatment as the optimal type of treatment" [5,6].

Hafsteinsdo'ttir, et al. investigated the effects of NDT on the functional status and quality of life of patients with stroke during one year after stroke onset. 223 patients were included in the NDT group and 101 of patients in the conventional treatment group. The NDT approach was not found more effective in the care of stroke patients in the hospital setting [7]. In a systematic review that 16 studies involving 813 patients with stroke were included and, was found Bobath Concept is not superior to other approaches [6]. Requirements for further research are suggested.

## Constraint-induced movement therapy

Constraint-induced movement therapy (CIMT) is a treatment technique for upper extremity rehabilitation among stroke patients that have hemiplegia and aims to increase functional use of the impaired upper extremity. The CIMT was developed by theory of monkeys that occurred learned nonuse after stroke [8-10]. CIMT has involved the constraining use of the unaffected upper extremity by a resting hand splint and sling for a period of approximately for 90% of waking hours, 2 weeks while giving the affected arm substantial practice in a variety of motor tasks. Wolfgang, et al. examined CIMT effectiveness in 15 chronic stroke patients. They were given CIMT, involving restriction of movement of the intact upper extremity by placing it in a sling for 90% of waking hours for 12 days and training of the more affected extremity for 7 hours in a day. Patients showed a significant and very large degree of improvement from before to after treatment on a laboratory motor test and on a test assessing amount of use of the affected extremity in activities of daily living in the life setting. The results indicate that CIMT is an effective and mostly preferred method for improving the rehabilitation of movement of the affected upper extremity in chronic stroke patients [11].

## Hydrotherapy

Mobility can be improved with hydrotherapy exercises for

stroke patients that they are able to perform activities in the pool that they are unable to perform on dry land. Zhu, et al. investigated the effectiveness of hydrotherapy in a total of 28 participants with impairments in walking and controlling balance. 14 of them were assigned to a land-based therapy and 14 of them to hydrotherapy. The results of this study suggest that a relatively short program (four weeks) of hydrotherapy exercise resulted in a large improvement in a small group of individuals with relatively high balance and walking function following a stroke [12].

### **Mirror therapy**

It has been used a method as “re-train the brain” as a means to enhance upper-limb motor function following stroke. During mirror therapy, a mirror is placed in the patient’s mid-sagittal plane and, the patient sees the reflection of the unaffected limb positioned as the affected limb in the mirror. This arrangement is suited to create a visual illusion and by this, the brain sees such effected limb moving normally. Some of the effects of mirror therapy on the brain have already been demonstrated in the literature. Thieme, et al.’s research included 14 studies with a total of 567 participants, which compared mirror therapy with other interventions. When compared with all other interventions, mirror therapy was found to have a positive significant effect on motor function and activities of daily living [13,14].

In a randomized controlled study, patients were randomized to treatment and control groups. The treatment group was given mirror therapy for 1-2 hours/day for 5 days/week, for 4 weeks period with limb activation and the control group received only limb activation. It was found that mirror therapy with limb activation is more effective in improving unilateral neglect in stroke patients [13,14].

### **Neuromuscular electrical stimulation**

Since the early 1960s, Neuromuscular Electrical Stimulation (NMES) has been used to support the rehabilitation of stroke patients. In sports medicine, NMES has been used for muscle strengthening, maintenance of muscle mass. In stroke mostly used to facilitate motor learning in ankle dorsiflexion and wrist extension [15].

Drop-foot and gait dysfunction are the most permanent problems in stroke. NMES improves gait speed in subjects post stroke and activates the use of external muscle stimulation to correct drop-foot. Also, inhibit spasticity. A muscle amplifier improves adequate ankle movement for upright stance during postural perturbations. It also has been shown to be beneficial in reducing shoulder subluxation. Kimberley, et al. defined that the mechanism of benefit of NMES is unknown, but increased synaptic effectiveness has been suggested [15].

### **Telerehabilitation**

Telerehabilitation (TR) can contribute to ensuring that patients receive the best care at the right time. “TR is the use of telehealth technologies to provide distance support, rehabilitation services and information exchange between people with disabilities and their clinical providers”. “Information and communication technologies are used to facilitate communication between the healthcare professional and the patient in a remote location. The use of telerehabilitation is becoming more viable as the speed and sophistication of communication technologies improve” [16,17].

In a study 52 patients were included and the multifaceted stroke telerehabilitation intervention effects on physical function and, disability researched. A significantly improvement in physical function, with improvements persisting up to 3 months after completing the intervention was found [17].

### **Virtual reality**

Virtual Reality (VR) has emerged as a new treatment approach in stroke rehabilitation. This approach may be advantageous because it provides the opportunity to practice activities that cannot be practiced within the clinical environment. There are many different problems in the clinic such as time of the patient and the therapist, lack of motivation and materials. Furthermore, virtual reality programs are often designed to be more interesting and enjoyable than traditional therapy tasks [18]. “VR exercise applications have the potential to apply relevant concepts of neuroplasticity such as repetition, intensity, and task-oriented training of the paretic extremity” [19].

Laver, et al. included 10 randomized controlled trials comparing VR with an alternative intervention or no intervention in people diagnosed with stroke. Results showed a statistically significant effect on arm function. But they did not find virtual reality and interactive video gaming is better than conventional therapy [16,18].

### **Somatosensorial rehabilitation**

The somatosensorial deficit is among the most frequent and neglected outcomes of cerebral lesions. Sensorial dysfunction affects the motor function. The somatic sensation is impaired in 60% of stroke patients. The most evident consequences of the somatosensory deficit are deficits in tactile recognition and manipulation of objects. But sensorial assessment and rehabilitation can’t take place in the rehabilitation program and mostly neglected by the clinicians. There are little studies about sensorial rehabilitation and there are not standard and evidence-based methods in sensorial rehabilitation [20-22].

Smania, et al. examined the effectiveness of sensorial rehabilitative training program for deficits in somatic sensation and motor control of the hand in patients with pure sensory stroke. Thirty treatment sessions, each lasting 50 minutes, were performed. Possible effectiveness of the training program for treating somatic and motor control deficits of the hand in patients with cortical or subcortical pure sensory stroke was found [22].

### **Yoga**

“Yoga is a philosophical system that originated in India approximately 4,000 years ago, and it was primarily intended as a means toward increasing self-awareness” [23]. Yoga is a method of alternative medicine and there are many studies about alternative medicine for stroke in the literature. In some studies it was defined that yoga had positive effects on motor and cognitive functions [24-26]. Lazaridou, et al. reported that yoga could be clinically valuable self-administered intervention options for stroke rehabilitation. Five randomized controlled clinical trials and four single case studies were examined in a review. They declared that studies reported positive results, including improvements in cognition, mood, and balance and reductions in stress [24]. Arlene, et al. Panned a pilot study to examine the efficacy of yoga after stroke. They randomized the groups as control, group yoga, group yoga plus home yoga. There were no

significant differences between control (n=10) and yoga (n=37) groups in baseline or follow-up scores. However, using within-group comparisons, yoga group data demonstrated significant improvement in balance [25]. Lynton, et al. conducted a study in which stroke victims participated in a regular yoga practice. In their study the 3 participants attended yoga classes twice a week for 12 weeks, before and after which they were tested on the O'Connor Tweezer Dexterity test, a timed test where the participant places pins in a Peg-Board with tweezers, and the Boston Aphasia Exam for speech. All 3 participants showed improvement on both measures [23]. Yoga has positive effects on stroke patients in many factors. So Yoga should be included in the routine stroke rehabilitation.

## Conclusion

Between 55% and 75% of survivors continue to experience motor deficits associated with reduced quality of life [27]. Rehabilitation is the companion of the stroke patients for a lifetime. Stroke patients have a different level of motor, sensorial, cognitive problems. There are many different methods for stroke rehabilitation. Stroke rehabilitation should be holistic and all the symptoms should be rehabilitated. The goals of rehabilitation should be to help survivors to become as independent as possible and to attain the best possible quality of life by using different methods.

## Summary

Rehabilitation is one of the most important phases of recovery for many stroke survivors. There are many different methods for stroke rehabilitation. Neurodevelopmental Therapy, Mirror Therapy, Neuromuscular Electrical Stimulation, Tele-Rehabilitation, Hydrotherapy, Constraint-Induced Movement Therapy are the most popular methods.

## References

- Murray CJ, Lopez AD. Global mortality, disability and the contribution of risk factors. *Global burden of the disease study. Lancet.* 1997; 349: 1436-1442.
- Saka O, Mcguire A, Wolfe C. Cost of stroke in the United Kingdom. *Age and Ageing.* 2009; 38: 27-32.
- Clarke DJ, Forster A. Improving post-stroke recovery: the role of the multidisciplinary health care team. *J Multidiscip Healthc.* 2015; 8: 433-442.
- Foley N, Cotoi A, Serrato J, Mirkowski M, Harris J, Dukelow S, et al. Upper Extremity Interventions. *Evidence-Based Review of Stroke Rehabilitation.* 2016; 1-184.
- Paci M. Physiotherapy Based On The Bobath Concept For Adults With Post-Stroke Hemiplegia: A Review of Effectiveness Studies. *J Rehabil Med.* 2003; 35: 2-7.
- Kollen BJ, Lennon S, Lyons B, Smith LW, Scheper M, Buurke JH, et al. Effectiveness of the Bobath Concept in Stroke Rehabilitation What is the Evidence? *Stroke.* 2009; 40: 89-97.
- Hafsteinsdóttir TB, Algra A, Kappelle LJ, Grypdonck MHF. Neurodevelopmental treatment after stroke: a comparative study. *J Neurol Neurosurg Psychiatry.* 2005; 76: 788-792.
- Taub E, Goldberg IA. Use of sensory recombination and somatosensory deafferentation techniques in the investigation of sensory-motor integration. *Perception.* 1974; 3: 393-405.
- Taub E, Heitmann RD, Barro G. Alertness, level of activity, and purposive movement following somatosensory deafferentation in monkeys. *Annals of the New York Academy of Sciences.* 1977; 290: 348-364.
- Reiss AP, Wolf SL, Hammel EA, McLeod EL, Williams EA. Constraint-Induced Movement Therapy: Current Perspectives and Future Directions. *Stroke Research and Treatment.* 2012; 159391: 8.
- Miltner WHR, Bauder H, Sommer M, Dettmers C, Taub E. Effects of Constraint-Induced Movement Therapy on Patients with Chronic Motor Deficits After Stroke A Replication. *Stroke.* 1999; 30: 586-592.
- Zhu Z, Cui L, Yin M, Yu Y, Zhou X, Wang H, et al. Hydrotherapy vs. conventional land-based exercise for improving walking and balance after stroke: A randomized controlled trial. *Clin Rehabil.* 2016; 30: 587-593.
- Thieme H, Mehrholz J, Pohl M, Behrens J, Dohle C. Mirror Therapy for Improving Motor Function After Stroke. *Stroke.* 2013; 44: 1-2.
- Arora R, Kaur P, Dheeraj KV, Mathangi S, Sharma D, Pandian J. Effectiveness of Mirror Therapy in Stroke Patients with Unilateral Neglect-A Randomized Controlled Trial. *International Stroke Conference Moderated Poster Abstracts. Multidisciplinary Clinical Rehabilitation Moderated Poster Tour I.* 2013; 44: 87.
- Kimberley TJ, Carey JR. Neuromuscular electrical stimulation in stroke rehabilitation. *Minn Med.* 2002; 85: 34-37.
- Laver KE, Schoene D, Crotty M, George S, Lannin NA, Sherrington C. Telerehabilitation services for stroke. *Cochrane Database Syst Rev.* 2013; 12: 010255.
- Chumbler NR, Quigley P, Li X, Morey M, Rose D, Sanford J, et al. Effects of Telerehabilitation on Physical Function and Disability for Stroke Patients A Randomized, Controlled Trial. *Stroke.* 2012; 43: 2168-2174.
- Laver K, George S, Thomas S, Deutsch JE, Crotty M. Virtual Reality for Stroke Rehabilitation. *Stroke.* 2012; 43: 20-21.
- Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: a systematic review. *Lancet Neurol.* 2009; 8: 741-754.
- Sterzi R. Hemianopia, hemianesthesia and hemiplegia after right and left hemisphere damage. A hemispheric difference. *J Neurol Neurosurg Psychiatry.* 1993; 56: 308-310.
- Mauguie' re F, Desmedt JE, Courjon J. Astereognosis and dissociated loss of frontal or parietal components of somatosensory evoked potentials in hemispheric lesions. *Brain.* 1983; 106: 271- 311.
- Smania N, Montagnana B, Faccioli S, Fiaschi A, Aglioti SM. Rehabilitation of Somatic Sensation and Related Deficit of Motor Control in Patients With Pure Sensory Stroke. *Arch Phys Med Rehabil.* 2003; 84: 1692-1702.
- Lynton H, Kligler B, Shiflett S. Yoga in Stroke Rehabilitation: A Systematic Review and Results of a Pilot Study. *Top Stroke Rehabil.* 2007; 14: 1-8.
- Lazaridou A, Philbrook P, Tzika AA. Yoga and Mindfulness as Therapeutic Interventions for Stroke Rehabilitation: A Systematic Review, Hindawi Publishing Corporation Evidence-Based Complementary and Alternative Medicine. 2013; 357108: 9.
- Schmid AA, Puymbroeck MV, Altenburger PA, Schalk NL, Dierks TA, Miller KK, et al. Poststroke balance improves with yoga: a pilot study. *Stroke.* 2012; 43: 2402-2407.
- John S, Khanna G, Kotwal P. Effect of music therapy and meditation along with conventional physiotherapy management in sub-acute stroke patients. *British Journal of Sports Medicine.* 2010; 44: 14.
- Nichols-Larsen DS, Clark PC, Zeringue A, Greenspan A, Blanton S. Factor's influencing stroke survivors' quality of life during subacute recovery. *Stroke.* 2005; 36:1480-1484.