



**COMBINED EFFECT OF ELECTRICAL STIMULATION AND MOTOR RELEARNING PROGRAM APPROACH IN PATIENT WITH STROKE, AN OLD FEMALE: A CASE STUDY**

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**ABSTRACT**

Most commonly stroke results in disability and functional difficulties. Patients have to face problems during daily activities of life especially using in wrist and hand. Targeted exercises along with electrical stimulation can be an option to overcome these problems. Aim of study is to evaluate and treat the motor impairments occurring after stroke. A data from single (old female) case was taken. Patient was still having mild pain and severe weaknesses in upper extremity following 3 months of stroke. Patient ability (strength of wrist and hand) to perform daily activity of life was evaluated with Fugal-Meyer scale and pain was rated with Visual analog scale. Pain and severe muscular impairment were associated with stroke and its effects. And inadequate assessment and treatment of physical condition contributed to wrist and hand disability a large. Following combined treatment with neuromuscular electrical stimulation and motor relearning program approach created a huge improvement (Fugal-Meyer score from 14 to 21) of the patient's ability. Muscular impairment following stroke were found to be due to brain damage and insufficient exercise program to solve and manage the condition. Patient was dependent over others. So there is a need to handle this condition carefully. Timely and specific treatment becomes mandatory. In this study combined treatment with electrical stimulation and motor relearning program could be effective in treating the wrist and hand functional issues.

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**INTRODUCTION**

Stroke is the most frequently occurring disabling disease in the world. This is a clinical syndrome describing a range of disorders which result in focal ischemia. Both the Cerebral infarction and intra cerebral hemorrhage are the cause for stroke. (1) According to W.H.O. stroke is defined as rapidly developing clinical signs of focal disturbance of cerebral function which ends after 24 hours or sometimes leading to death. (2) The initial causes for stroke are cerebral thrombosis, cerebral hemorrhage and cerebral embolism. Stroke is having risk factors such as heart disease, hypertension, diabetes, obesity and high level of cholesterol. (1)

Persons who have had strokes causing hemiplegia for them functional recovery are very important facts. Motor recover in these patients are very slow and depends upon the following factors such as degree of severity alongside amount of time prior to voluntary movements are started. (3) In these patients common clinical presentations are in the form of motor impairment that includes like muscle weakness, changed muscular tone, laxated joints, contracture and motor control deficits. Thus upper extremity complications are frequently seen after stroke including impaired wrist and hand function.

(4) While considering recovery time for strokes patients, most notably being the initial 3 to 6 months following brain attacks. However other studies are showing that recovery time may extend year's later. Early and effective intervention after strokes can up regulate recovery process and decrease functional difficulties. (2) In India most commonly premature death and disabilities are owing to stroke. Then medical treatment is carried out after making a proper diagnosis with the help of radiology. (5)

Summen *et al* concluded that a good functional outcome relies on the recruitment of functional network rather than on brain plasticity. (4) So function based approach called for motor relearning program may be of great help in case of stroke. It is a task oriented approach focusing on regaining activities to up regulate motor performance. Therefore it could be of prime importance after brain attacks to enhance the function significantly. (6)

Nonetheless, Functional performance after stroke is considered to be as highly dependent upon pain severity and muscular strength. Therefore electrical stimulation could be taken into account to reduce pain and improve muscle strength following stroke. Artificially controlling human muscles via neuromuscular electrical stimulation (NMES) is used in clinical practice extensively in case of spinal cord as well as in stroke conditions. Motor recovery is enhanced by using this

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modality. And in this intervention a number of parameters are used to reduce pain and improve muscular strength. (7) This device has multitude of uses and can prevent muscular atrophy. Especially in case of stroke this could reduce edema and restore activities. (8) Therapeutic application of electrical stimulation may include upper and lower limb motor relearning and reeducation. During procedure surface electrodes are positioned on the skin over the motor points of targeted muscles. (9)

The expected increase in number of stroke survivors especially living with functional disabilities will definitely causing burden over family, community and health care system. Society and individual both are paying for stroke related disabilities a lot. Therefore there is need of effective treatment for patients with strokes. (10) Even researches regarding the outcomes of physiotherapy is not explored fully. So if patients with strokes involving wrist and hands are provided with both the neuromuscular electrical stimulation and motor relearning approach then motor function can be improved at a faster rate and more gaining in recovery may results. Thus these physical interventions for restoring more normal functions could be of quiet importance.

**METHODOLOGY**

**Case report:** A 65 years old female presented with left hemiplegia. She had a complaint of mild pain and severe weakness of her left wrist and hand. She was in so trouble that she was unable to lift her left hand or even move them. She had a right cerebro-vascular accident (C.V.A.) since 4 months. And she was on proper medication alongside following physical treatment as well. However, she could not receive anything. Her wrist and hand still were not functioning. Therefore she was frustrated and seeking for any miraculous treatment for the same.

When patient entered into our department, on presentation her left shoulder was retracted, elevated and abducted. Her upper extremity was seemed to be in synergistic posture. And forearm was pronated with flexed elbow including wrist and finger flexed as well as tight. She had a flexed posture with contralateral trunk bending. And her lower extremity was externally rotated alongside pelvic retraction. She could walk with circumductory gait and needed assistance. Patient could not do anything with her left hand. And her upper limb was more involved than lower limb. She was looking like frustrated and questioned to me, is it not possible to overcome with this problem, So that we would be able to do at least daily activities of my life.

**On examination:** clinical findings- her pain score of left extremity was 4 out of 10 only on Visual analog scale. And patient could bear it without significantly disturbance. And she was O. Key with her pain.

Her upper limb under consideration was severely weakened therefore inability was found to do activity of daily life even. She could not reach and hold herself anything. And she made a score about 14 out of 24 on Fugal-Meyer functional scale for her upper limb (especially for wrist and hand function).

**Interventions:** on the basis of history and examination treatment plan was carried out.

The neuromuscular electrical stimulation was decided to given on the daily basis and in a single session. And nine contractions for each and every muscle were given in the course this session. And repetition was made up to 10 times in a session for each and every extensor muscle of forearm. Thus a total of 90 contractions were provided among them.

During the course of treatment, pulse duration was fixed at 140millisecond for one month initially. And in second month it was fixed at 120millisecond. And thereafter it was maintained at 90millisecond for next one month. Thus a total of 3 months duration was followed. And to produce good contraction of extensor muscles of forearm intensity was adjusted according to need.

Having treated with electrical stimulation, 15 minutes rest was assured. Thereafter motor relearning program (MRP) was executed in the same session of physical intervention daily. In this, preferred selection of missing component in terms of wrist and hand extensors was carried out and 30 repetitions were given separately for each and every extensor muscles of forearm daily for one month. Then combined wrist and finger activities were performed for next one month. And finally these activities were performed with different task and in different environment alongside different challenges for the last month of treatment. This total a 3 month program was introduced after each session of electrical stimulation for approximately 30 minutes daily.

So a total of approximately 1 hour combined treatment including rest between two (NMES and MRP) was given in a single session daily for three months.

**OUTCOMES/RESULTS**

After 3 months of combined treatment with NMES and MRP following findings were

**Table 1**

S. N.	Treatment timelines	Treatment Parameters (pulse duration)	Score on Fugal-Meyer scale	Score on VAS
			(function)	(pain)
1.	0-1 Month	140 ms	16 after 1 month	3 after 1 month
2.	0-2 Month	120 ms	18 after 2 month	2 after 2 month
3.	0-3 Month	90 ms	21 after 3 month	0 after 3 month

Patient’s pain was zero on VAS scale. She had a score of 21 out of 24 for wrist and hand function on Fugal-Meyer scale. And patient could do number of activities including activities of daily life. Thus she was so happy and said thanks for our efforts.

**Outcome measures**

(i)VAS (visual analog scale) is a one-dimensional measure of pain intensity. VAS is self completed by respondent. It is a 10 point scale start from zero. Zero indicates no pain and 10 indicate worst pain. Thus high score indicate greater pain intensity. And VAS takes only <1 minute to complete.

(ii)Fugal-Meyer assessment scale is an index to assess the sensorimotor impairment in individuals who have had stroke. It is now widely used for clinical assessment of motor function in patients with stroke. The Fugal-Meyer assessment has been

tested several times, and is found to have excellent consistency, responsiveness and good accuracy.

## DISCUSSION

Most neurologists are in favor of brain attack rather than accident. And stroke is the 5th leading cause of death and first rank is issued in terms of disability. There are generally a total of 6 types of strokes including 4 types of ischemic and 2 types of hemorrhagic. (11) Stroke is also a major contributor to disabilities. Therefore early management of stroke victims can maximize the chance of recovery and decrease the chance for disability to develop. (12) Thus improper understanding of path physiology of stroke being the major restrictions that causes research progress to limit. (13)

Therefore Long term disabilities caused by strokes are in connection with upper limb especially for wrist and hand. They will lead to pain, paresis, loss of sensation and spasticity in the upper limb including wrist and hand. These problems can have number of results in the daily lives of affected persons. (14)

Others studies suggested that in strokes patients functional difficulties are the area of major concerns. Therefore activities of daily lives are grossly hampered leading to increased dependencies over family members. In this study greater focus has been provided to overcome these types of functional issues.

The results of this study had shown that neuromuscular electrical stimulation caused a big change in motor performance of concerned patient. Thus neuromuscular electrical stimulation could be of great help. Researches in relation to strokes have suggested that paresis of muscles being the most notably contributing factor to inability to perform daily tasks. Weakness in partially paralyzed individuals is a impairment for people with neurological conditions. For this several studies suggest a modest beneficial effect of electrical stimulation in patients with strokes. (15) Also Alicia Canning *et al* demonstrated that electrical stimulation restores motor functions and similarly to exercise, it can also be used to restore much of muscular strength. (16)

A study by Yochewed Laufer *et al*, emphasized that somatosensory input may lead to long lasting cortical plasticity enhanced by motor recovery in patients with neurological impairments . sensory stimulation via trans cutaneous nerve stimulator may be beneficial to enhance aspects of motor recovery following stroke.(17)thus neuromuscular electrical nerve stimulator(NMES) not only increases the muscle strength by stimulating it but also it provides sensory stimulus that could be also possible cause of increased muscle activity and finally motor recovery after stroke.

Similarly few studies conducted with humans, which applied low or high frequency current during NMES. They observed up regulation of one or more anabolic signaling protein.

Joni A Mettler *et al* stated that high frequency electrical stimulation increases anabolic signaling that will results in increased muscle mass thus increased motor performance. (18) This study had used electrical stimulation. Therefore both the

responses in the form of sensory stimulation and anabolic signaling could be the cause of increased muscle strength in patients with strokes.

Basically two types of strokes are seen in population. And they are specially ischemic and hemorrhagic. And most of the cases about 80% are related to ischemic categories. Patients are usually associated with Impaired motor control and decreased level of functional activities. In this study MRP (motor relearning approach) had applied in the form of physical activities. And outcomes of this study had suggested that MRP could up regulate the strength of extensor of forearm leading to enhanced performance of wrist and hand.

Yong Yin *et al* evaluated that MRP can significantly improve the function of patients with brain ischemia, and can produce neuroprotective effects.(6) so these effects might be the cause of improved motor performance after treatment with MRP approach. MRP describe the ways in which motor pattern can be acquired and modified through experimental learning. The major assumptions about motor control underlying this program is the regaining the ability to perform motor tasks, involves a learning process and number of path of central nervous system mediate the same motor function.(1)

Another study done by suneel kumar *et al* also concluded that MRP are important to improve functional recovery of stroke. (1).according to Jori de Fernadesss motor relearning program approach had up regulated the motor outcomes in chronic stroke patients as well. Changes were seen in upper limb especially in wrist and hand functions. MRP has led better skill acquisition and retention. The reason could be due to repeated practice in MRP. (5) In this approach first missing component is find out and then practice is done by repeated tasks in same environment then different environment. This practice may have effects on brain plasticity and functional outcomes may be long lasting. All these factors could improve motor performance in a better way any other type of treatment. MRP have emphasized over elimination of unnecessary movement and practice of necessary movement alongside feedback. These criteria cause relearning of activities simple and effective. Thus patients with strokes can gain maximum in short period of time and have long term effect.

## CONCLUSION

Stroke is the leading cause of impairment and disability. And upper limb disability is more common post stroke worldwide. Patients with stroke are facing number of difficulties after stroke in the form of motor performance. There are many studies showing the value of NMES in treating post stroke impairment associated with muscular weakness. Additionally, other studies are also reported to be effectiveness of MRP approach following stroke considerably. Therefore, it is assumed that these combined strategies in this study would provide similar results to those studies reviewed from literature.

**Limitations:** obviously single case study can be further generalized by increasing sample size. And further research can be carried out if other aspects are analyzed like patient's

alienation. These factors also affect the recovery from motor impairment.

### Conflict of Interest

No conflict of interest

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