



Effect of Functional Electrical Stimulation on Upper Limb Motor Functions in Patient with Chronic Stroke - A Case Report

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case study

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ABSTRACT

Background: Literature shows that intensive Functional Electrical Stimulation facilitates upper limb motor recovery after Stroke.

Aim: To assess the effects of 4 weeks of FES therapy on right upper limb motor functions in patient with Chronic Stroke.

Materials and Methods: The participant was thirty year old male Right Hemiparesis who had experienced Chronic Ischemic Stroke. FES therapy was given for forty five minutes per session, three sessions a week for complete four weeks. The pre and post intervention score were measured with Fugl Meyer Assessment, Voluntary Control Grading and MAS.

Results: The Fugl Meyer Assessment score for right upper limb showed improvement with progression in stage of VCG for right upper limb and hand. Also improved MAS score was noted for right shoulder, elbow and hand muscles.

Conclusion: The current study confirms that application of FES therapy improves upper limb motor functions in Chronic stage of Stroke after 4 weeks.

Keywords: Chronic stroke; functional electrical stimulation; upper limb; motor function.

ABBREVIATIONS

FES	:	Functional Electrical Stimulation.
FMA	:	UL- Fugl Mayer Assessment - Upper Limb.
VCG	:	Voluntary Control Grading
ROM	:	Range of motion.
MCIMT	:	Modified Constraint Induced Movement Therapy.
MAS	:	Modified Ashwath Scale
ADLs	:	Activities of Daily living.

1. INTRODUCTION

Stroke is defined as a clinical syndrome of presumed vascular origin, typified by rapidly developing signs of focal or global disturbances of cerebral function lasting for more than twenty four hours or leading to death (World Health Organization) [1].

Stroke is classified into Anterior cerebral artery infarct (ACA), Middle cerebral artery infarct (MCA) and Posterior cerebral artery infarct (PCA) [2]. The blockage in Middle cerebral artery is the most common type in stroke. The most common impairments of MCA infarct are spastic hemiparesis and sensory loss with the face and upper extremity more involved than lower extremity and is associated with lesions in Motor and Sensory Cortex [3,4]. There are various Conventional and Recent Advance treatment protocols in literature for improving Upper Limb functions like Mirror therapy, MCIMT, Bobath, Brunnstrom⁹, Matrix, FES, etc.

FES is the recent advancement in the field of Neurophysiotherapy. The Functional Electrical Stimulation is the utilization of electrical current for Contractile tissue to facilitate the function that is lost in Neurological patients. FES therapy stimulates afferent nerves which increases nerve Excitability in paretic area and provides Neuroplasticity changes [5].

Various studies found that FES is successful for improving upper limb functions such as reaching, holding, grasping, moving and releasing objects. FES therapy is also helpful in reducing spasticity, increasing range of motion and motor control. Therefore, we aimed to examine the effect of Functional Electrical Stimulation Therapy in Upper Limb Motor functions in patient with Chronic Stroke [6].

2. CASE DESCRIPTION

The study subject was a thirty year old male Right Hemiparesis and Flexion Synergy of Right Upper Limb who had experienced an Ischaemic Stroke in the left Frontal, Parietal and Temporal lobes, secondary to obstruction in Middle cerebral artery, sixteen months before the study. According to practice guideline endorsed by American Heart Association and American stroke Association, he can be considered as a Chronic Stroke patient (the guidelines define Chronic Stroke as >six months post- stroke). Prior to study, patient's Motor recovery status of Upper Extremity was measured by FMA [7,8,9] which was 6 (of 66 possible) with shoulder movements, elbow flexion and extension, supination and pronation of forearm, flexion, But extension of wrist, fingers movements was impossible. The Voluntary Control Grading of upper limb grade 3 and hand was grade 2. The MAS score for muscles of shoulder 2+, elbow 2+ and wrist 3+.

Functional electrical stimulation: FES therapy was given with MEGAXP electrical stimulator which is multichannel fully programmed FES system with surface electrodes used to deliver stimulation pulses secured on skin with adhesive tapes. The muscles that were stimulated are as follow: Deltoid, Biceps and triceps brachialis, extensor carpi radialis, extensor carpi ulnaris, flexor carpi radialis and flexor carpi ulnaris Fig. 1. The Muscles were stimulated with Symmetrical Biphasic pulsed current with pulse duration of 250 microseconds. The ramp-up and ramp-down period was for 2 seconds with frequency of 35 Hz was used.

FES Therapy Protocol: The therapy includes preprogrammed coordinated muscular stimulation and Active range of motion of upper limb to produce Functional movements. Patient performs following movements during FES therapy: 1) reaching for a bottle of water 2) grasping a bottle of water 3) bringing a bottle of water to mouth Fig. 2. Total treatment duration was 45 minutes per session for 3 alternate days in a week. FES therapy was given for 4 complete weeks. Each task was performed 20 times during single treatment session.

3. RESULTS

After 4 weeks of FES therapy, we found that FES therapy has positive effects on upper limb motor

recovery in Chronic Stroke patient. After therapy, patient showed improvement in MAS score for muscles of shoulder, elbow and wrist. Prior to therapy FMA-UL score was 6 and post - therapy score improved to 16 and VCG for upper limb (grade 3 to 4b) and hand changed from grade3 to grade 3c. Table 1.

4. DISCUSSION

This study assessed the effectiveness of FES therapy on Upper Limb Motor functions in the management of Chronic Stroke patient. After application of FES therapy improvement in outcome measures was seen that was attributed to ability to flex and extend the elbow , ability to grasp object of different shapes (cylindrical, spherical, etc) and ability to elevate (flexion and abduction) the shoulder within the synergy pattern. The patient's pre-treatment FMA Upper limb score was 6 and Post- treatment score was increased to 16. The pre-treatment VCG of upper limb was grade 3 which changed to 4b and hand changed from grade3 to grade 3c. The result also showed improvement in MAS score for muscles of shoulder, elbow and hand.

According to T Adam Thrasher.et al. application of 12 to 16 weeks of FES therapy, which involves

proximal muscle stimulation during reaching task and distal muscle stimulation during grasp and pinch tasks, improves hand function and minimize upper extremity impairments in severe stroke patient during Subacute Stroke rehabilitation. This study was parallel to our study [10].

Similar to our study, SH Peurala, et al. conducted a study in which 59 patients with chronic stroke was enrolled for FES in upper limb to improve activity of daily living. The study Showed that application of functional electrical stimulation had beneficial effects on motor performance and sensations of limb in Chronic Stroke patient leading to improvement in ADLs [11].

A randomized controlled trial was done by tiebin.et al. in which 46 acute stroke patients was evaluated for walking ability. There was 3 groups: FES with standard rehabilitation or Placebo stimulation or control group. The study concluded that FES with standard rehabilitation improved motor and walking ability in Acute Stroke patients [12].

Limitation of the study there was no follow after the intervention.



Fig. 1. Electrode placement

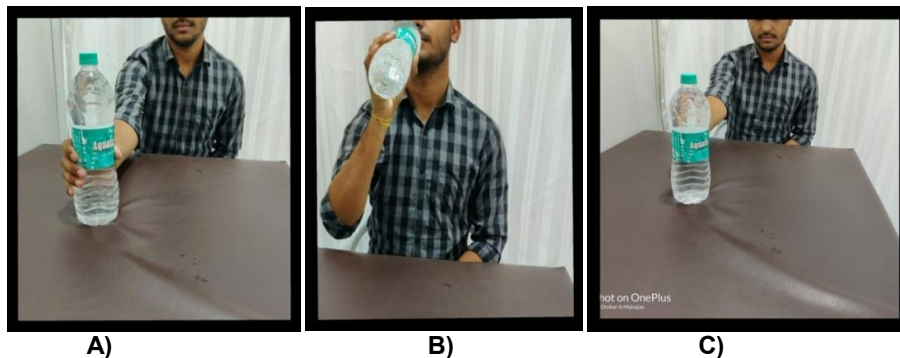


Fig .2. a) Reaching for a bottle of water. b) grasping a bottle of water. c) bringing a bottle of water to mouth

Table 1. Pre-post outcome measures

Outcome measures	pre - therapy	Post - therapy	Difference
1.FMA for Right Upper Limb			
A.UPPER EXTREMITY	6/36	10/36	
B. WRIST	0/10	2	
C. HAND	0/14	2	10
D. COORDINATION / SPEED	0/ 6	2	
TOTAL A-D (Motor Function)	6/66	16/66	
2.VCG for Right Upper Limb	Grade 3	Grade 4b	01
VCG for right hand	Grade 2	Grade 3C	01
3.MAS			
A. Shoulder flexor ,extensors ,abductors	2+	1+	01
B. Elbow flexors and extensors	2+	1+	01
C. Wrist flexors and extensors	3+	2+	01

5. CONCLUSION

The current study confirms that application of FES therapy improves upper limb Motor functions in chronic stage of Stroke, which supports previous studies.

CONSENT

The written informed consent was taken by the patient for enrollement, Images and Publication of the article.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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