

CASE REPORT

IJPHY

EFFECT OF ELECTRICAL MUSCLE STIMULATION WITH SENSIROMOTOR TRAINING IN FOCAL HAND DYSTONIA - A CASE REPORT

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ABSTRACT

Background: Focal hand Dystonia is shown by involuntary muscle contractions in the arm or hand while writing with a disordered neuroplastic changes in the brain. Symptoms can include lack of coordination, cramping and tremor and tend to be specific for each individual. So, the present study evaluates the effect of an integrated approach that is employed to improve functional independence in a patient suffering from focal hand dystonia.

Case Description: The benefits of sensorimotor task specific training along with electrical muscle stimulation in the rehabilitation of focal hand dystonia is reported in this study. The treatment protocol is planned according to the problem list of the patient and an intervention of 20 days (1 hour per day, 5 days per week for 4 weeks) is given to the patient.

Outcome Variables: Prognosis is observed in Burke-Fahn-Marsden scale, global dystonia scale, Jedynek's protocol and unified dystonia rating scale before & after the intervention. A Depression anxiety stress scale is also used to assess the psychological status of the patient.

Conclusion: Considerable improvement is seen in writing and fine motor skills after the rehabilitation. It is observed that the electrical muscle stimulation in conjunction with sensoriromotor task specific training induces excitability in the muscles and improve the clinical function in patient with focal hand dystonia.

Keywords: dystonia, hand, sensoriromotor training, Handwriting, Electrical Stimulation

Received 28th December 2014, revised 05th January 2015, accepted 21st January 2015



www.ijphy.org

DOI: 10.15621/ijphy/2015/v2i1/60035

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INTRODUCTION

The word dystonia originates from the Greek word “dys”, meaning abnormal, bad, impaired, mis-, not good, difficult, non-functional and “tonia” from the word “tonos”, meaning tension.¹ The term dystonia describes a syndrome characterized by sustained contraction of opposing muscles which twist the body region affected into an abnormal position. Dystonic movements are not typically associated with pain, except in the case of cervical dystonia. Movements are repetitive, may be rhythmic, and can range from slow and athetotic, to rapid and jerky.²

It is a potentially disabling movement disorder, and reduced mobility, pain and a significant psychosocial impact are some of the consequences. Three criteria can be utilised to assist in classifying this syndrome: age of onset, aetiology and distribution of symptoms.^{3,4} Onset before 28 years of age is classified as early, and after this age is classified as late onset dystonia. Etiology can be divided into primary/idiopathic (no obvious affects on the brain) or secondary/symptomatic (often the basal ganglia are affected, resulting in more generalised symptoms. Distribution can be: general – symptoms manifest in all extremities including the trunk; hemi – symptoms are focussed on one side of the body or segmental – a segment of the body is affected or focal – a single body part is affected.⁴

There are few studies specifically relating to the pathophysiology of dystonia. The general concepts as to why this complex sensorimotor network problem occurs are presented by Rosenkranz *et al.* 2005:

- Lack of inhibition on many levels of the nervous system, for example, at the spinal-cord level there is a lack of reciprocal inhibition and at the level of the motor cortex there is a reduction in intracortical inhibition.
- Impairment/failure of sensory integration results from impaired discrimination of the temporal/spatial ability and sensory input activates and leads to abnormal motor activation.
- Impairment/loss of somatotopic organisation in sensory and motor areas.⁵

Any part of the body can be affected by focal dystonia including the neck, eyelids, vocal cords or hand. Focal hand dystonia is a primary dystonia that is painless and tends to be task specific, focal and of late onset. Symptoms can include lack of co-ordination, cramping and tremor and tend to be specific for each individual.⁶

While dystonia can be secondary, due to for example structural lesions or neurodegenerative diseases, there is also primary dystonia, i.e. when dystonia (with or without tremor) is the only symptom, and there is no secondary cause or neurodegeneration. There is no cure for primary dystonia, partly also because its pathophysiology is still incompletely understood. Therefore, treatment is only symptomatic, aimed at decreasing the involuntary movements, correcting the abnormal posture, preventing contractures, reducing pain and ultimately attempting to improve quality of life. The current cornerstones of medical symptomatic treatment include chemodenervation with botulinum toxin injections, drug treatment with for example anticholinergics and surgical treatment such as bilateral pallidal stimulation. In addition, patients are referred for various allied healthcare interventions.⁷

Currently many physiotherapeutic interventions are offered to patients with dystonia. A commonly used treatment modalities for patients with dystonia as mentioned by Okun (2009) are muscle strengthening, Sensory tricks, active and passive stretching, relaxation techniques, EMG feedback training, TENS, sensori-motor training, splinting etc.⁸

Hallett (2006) raises the idea of patients who suffer from dystonia having a disordered neuroplasticity.⁹ The previous studies show that the use of low frequency currents (TENS) in the rehabilitation of focal hand dystonia induces neuroplastic changes in brain.¹⁰ So, the aim of the present study is to see the effect of electrical muscle stimulation in conjunction with sensori-motor training on focal hand dystonia.

CASE REPORT

A right handed 26 years old male presented with complaint of difficulty in writing, followed by pain & fatigue in the right hand. Patient felt some abnormal movements & vibration in the thumb & index finger since 3 months but the problem get worsen from past 4 days. He consults a local neurologist for treatment purpose but patient is not satisfied with the treatment. Then, he consulted a doctor in PGI, Chandigarh, where various tests are done like Electromyography, serological test, fundus examination & patient is diagnosed as a case of writer's cramp with idiopathic cause. Now patient is taking a medicine as prescribed by doctor. After taking medicine, patient is able to write but slowly & his symptoms get relived. But when patient is in off phase of medicine the symptoms starts appearing (after 6-7 hours of

medicine). (The source of history is patient himself & medical history is recorded from the investigatory reports carried by him).

Patient is a sports person but because of disability in right hand he skips his profession & now doing a job in railway & pursuing LLB (Part Time). No any genetic & family history is found. Family members are cooperative & supported in the treatment of patient. Patient is able to perform ADL's independently, only faces difficulty in fine movements, gripping & writing activities with right hand. Signed consent for the presentation of this case report is obtained from the patient concerned.

On observation, the thumb of right hand is in adducted position & wasting of thenar muscle is seen. When patient is came to OPD he is on phase of medication, the patient is asked not to take morning medication on the next day to see abnormal movements. The involuntary movement of thumb and index finger of right hand is seen both in resting as well as in doing any activity on next day. The facial expression and conversation with patient shows his depressive behaviour due to inability to write and do simple task with right hand. This depressive character of patient is evaluated by (DASS) Depression Anxiety and Stress Scale and he scored 24 for depression (severe), 7 for anxiety (normal) and 20 for stress (moderate). When the level of depression increases the patient also observe some abnormal movement in shoulder and feel pain in the mid-thoracic region.

On examination, the superficial, deep & cortical sensations are found to be intact (checked at dermatomal level). On Motor Examination, muscle tone as per Modified Ashworth Scale (MAS) is grade 0 i.e tone was normal in bilateral upper limb & lower limb. The range of motion (ROM) is assessed & it is within normal limits.

Functional motor evaluation of dystonia of hand is performed on the Burke-Fahn-Marsden scale (BFMS), global dystonia scale and Jedynak's protocol for assessment of writing quality.

Assessment of writing quality is noted during the task of writing the paragraph. The dystonic postures of the hand and forearm during writing, with index finger and thumb extension, wrist flexion and excessive pressure used to hold the pen is seen. The Jedynak's score for writing quality is 10.

On BFMS, in movement scale domain patient scored 3 for arm dystonia (Moderate) and on dystonia disability scale 3 (almost illegible) for handwriting. (Rest of the items in both movement and disability scale are normal).

In global Dystonia rating scale in which an analog scale of pain is used (rating 0 for no dystonia and 10 for most severe dystonia), patient rated himself as 2 for shoulder and proximal arm and 8 for distal arm and hand including elbow. Video recording of involuntary movement of hand is done after taking consent from the patient.

On the basis of history, investigation reports & examination a clinical diagnosis of focal hand dystonia is made. The Unified Dystonia Rating is used to rate the grade of disease severity, patient have 2.5 duration of involuntary movement which means frequent (50-75% of the time), predominantly submaximal and grade 3 (Severe) of right hand and grade 2 for right shoulder and proximal arm.

After assessing the main problems identified are difficulty in writing, difficulty in holding pen and mobile in hand, difficulty in doing fine movement and after doing simple tasks with right hand the patient felt fatigue. The main goals of physiotherapy treatment are-

1. Correction of posture of hand
2. Prevent deformities
3. Maintain strength
4. Education of patient
5. Improve fine motor skills
6. Improve writing quality
7. Psychological counselling

The treatment protocol according to problem list & goals are described in following table-

1. To induce cortical reorganisation/ neural plasticity	Electrical stimulation- Interrupted Galvanic current (IG) of APB, ECR, ED, EI- 3 sets of 30 reps each muscle for 20 days (5 days per week for 4 week)
2. Sensorimotor training	Sensory discrimination activities like-matching objects/shapes or textures, Braille reading, or identifying and manipulating common household objects with vision occluded.
3. Posture correction and prevention of deformity	<ul style="list-style-type: none"> • Modification of pen (advise to use large diameter of pen) ¹¹ • Modification of posture to hold the pen¹² • Stretching of adductor of thumb & MFR for thenar muscles to prevent deformity.
4. Improve quality of writing	<ul style="list-style-type: none"> • Advice to fill the one page of cursive handwriting book daily • Practice for doing his signature
5. Fine motor skills	<ul style="list-style-type: none"> • Peg board with holding of pegs as longer as possible for patient • Putting objects into a bowl with beans or rice.
6. Cognitive Behavioural training	<ul style="list-style-type: none"> • Teaching the patient to think positively about the recovery and imagine normal movements.
7. Home exercise Programme	<ul style="list-style-type: none"> • Dip both hands in luke warm water and do all movements of finger and wrist • Practice writing

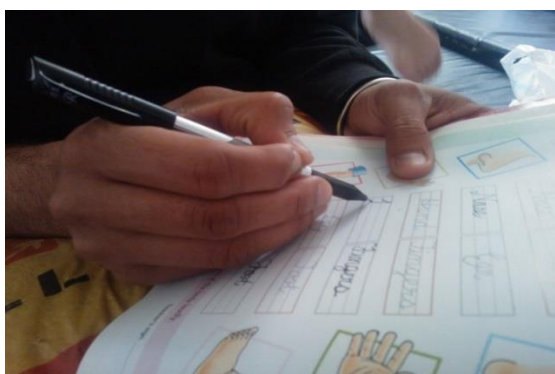
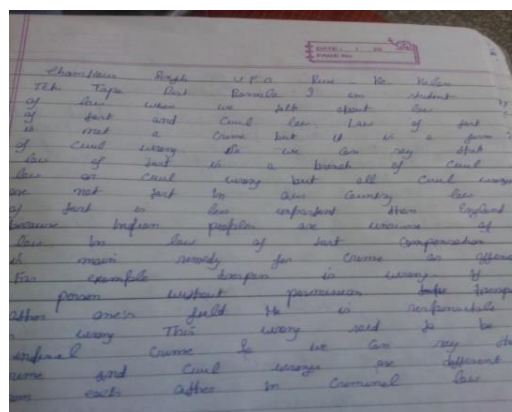
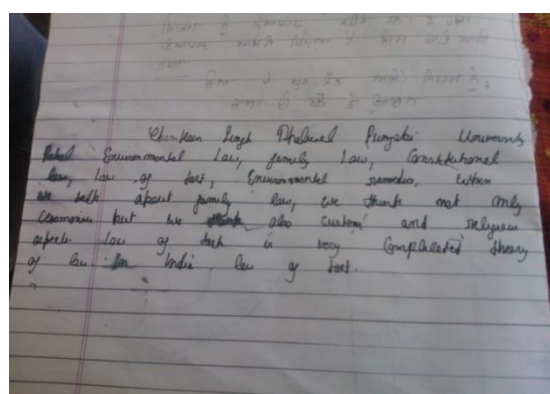


Fig. 1- Modification of posture to hold pen



(b)

Fig. 2- Writing assessment a(a) on 10th day, (b) on 20th day after the intervention



(a)

PROGNOSIS

After giving above mentioned physiotherapy treatment for 20 days (5 days per week for 4 weeks), patient is reassessed & following prognosis is observed in patient-

Subjectively, 60-70% improvement in writing process, now patient is able to write more than one page, able to do his signature perfectly, hold the mobile more than 2 min (previously was 20 seconds) and less abnormal movement is observed

than previously during the off phase of medication. On 15th day of treatment a BOTOX is injected in the thenar muscle of thumb, abductor pollicis brevis

and extensor digitorum but patient feels no improvement and said physiotherapy treatment is more effective than BOTOX.

Table 1: Outcome measurements to evaluate the prognosis before and after the treatment

Outcome measurement	Baseline evaluation	After 20 days
1. Jednyak' score for writing assessment	10	4
2. BFMS		
3. Movement scale	3(arm)	1(arm)
4. Disability scale	3 (handwriting)	1 (handwriting)
5. Global dystonia rating scale	2(Shoulder & Proximal arm) 8 (Distal arm and hand)	1(Shoulder & Proximal arm) 4(Distal arm and hand)
6. UDRS	2.5 duration 3(hand) 2(shoulder)	1.5 duration 1(hand) 1(shoulder)

DISCUSSION

It is showed that there is an involvement of sensory dysfunction in dystonic patient, to resolve this problem many therapies are being tried out. Byl et al. (2009) suggest that there is excessive excitation, poor spatial and sensory discrimination and an abnormal organization of the sensorimotor cortex in focal hand dystonia. The so called sensorimotor training is used to emphasize sensory input to improve the output of coordinated, fine motor movements. The components of the program comprise, amongst others sensory discrimination skills, an inhibition of abnormal movements by using cognitive strategies and visual or auditory feedback. The results suggest that a combination of sensorimotor with task specific training may be a successful strategy for the treatment of focal hand dystonia with a significant trend towards normalisation of movement patterns over time. Tailored task-specific training may allow normal cortical segregation to be re-established and normal fine motor control to be restored.^{13,14}

The application of low frequency stimulation improve writing time in patients with writer's cramp was studied by Messen et al. (2010). They hypothesized that intervention would remodulate cortical excitability of the muscles. The central processing of afferent muscle spindle signals may be abnormal in these patients, and the aim of the treatment is therefore to manipulate the afferent input to the motor cortex. This is achieved by applying electrical stimulation over the muscles of the hand to decrease the excitability of the stimulated muscles whilst increasing the excitability of the antagonists.¹⁰

CONCLUSION

A conservative therapeutic intervention strategy i.e. electrical muscle stimulation with sensorimotor training which is based on the principles of neuroplasticity can improve somatosensory structure and clinical function in a patient with focal hand dystonia.

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Citation

Shefali Gambhir, Narkeesh Arumugam. (2015). EFFECT OF ELECTRICAL MUSCLE STIMULATION WITH SENSIOMOTOR TRAINING IN FOCAL HAND DYSTONIA - A CASE REPORT. *International Journal of Physiotherapy*, 2(1), 327-332.