

The Efficacy of Conditioning Physiotherapy Protocol for Focal Arm Dystonia: A Case Report

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Abstract:- Focal arm dystonia (FAD) is also called as writer's cramp (WC), It is a specific task disorder, with wide range of symptoms of insidious onset and progress over month's and characterised by involuntary spasms of the hand, forearm and upper arm muscles, triggered selectively by writing and also may report tightness in the forearm or stiffness when writing or fatigue with prolonged writing or decreased speed and cramping with prolonged writing. A case report study of 21 year college going student with complaint of difficulty in writing and right hand twitching of index finger, inability and pain. We designed a symptomatic and conditioned based physiotherapy intervention for 4 weeks. Outcomes were Arm dystonia disability scale (ADDS), State trait anxiety inventory (STAI) and pre & post observation analysis of duration and quality of hand writing on day of intervention and after 4 weeks of intervention; there is improvement in all outcomes measures which concluded that , the conditioned based physiotherapy intervention will helps in reduced dystonia movements, pain, duration & quality of handwriting and improves in Activity of daily living.

Keywords:- Focal arm dystonia (FAD), Writer's cramp (WC) , Arm dystonia disability scale (ADDS), State trait anxiety inventory (STAI).

I. INTRODUCTION

A movement disorder associated with atypical posturing of the upper limb during performance of repetitive, fine motor or task specific movements describes focal arm dystonia also known as writer's cramp.^{1,2} Writer's cramp is a task-specific that negatively impacts handwriting ability. A range of symptoms like muscular hyperactivity to increased grip is experienced by patient³. Clinical symptoms of writer's cramp are usually insidious and progress over month's and characterised by involuntary spasms of the hand, forearm and upper arm muscles, triggered selectively by writing and also may report tightness in the forearm or stiffness when writing or fatigue with prolonged writing or decreased speed and cramping with prolonged writing⁴. Individuals who are affected may also notice lifting of the thumb or index finger off the pen or isolated finger extension. Patients also experience upper limb tremor, either during writing or as a postural tremor⁵.

There are 3 classifications of writer's cramp: simple, complex or progressive. When the presence of dystonia occurs only with the task of writing it is referred to as simple, When the patients are classified as progressive writer's cramp the dystonia extends to other manual tasks (e.g, typing, shaving, eating). Some patients have an initial onset with multiple tasks affected this type of writer's cramp is referred to as complex. There is 25% chance that writer's cramp may spread proximally or if the patient starts writing with the other hand it may spread to non-affected hand. Spontaneous remissions are rare, occurring in about 5%, and more likely to occur earlier in the course^{6,7}.

The aetiology of WC remains still unclear , but recent evidences suggest the involvement of brain pathology, genetic and environmental factors stats that a) In genetically predisposed individuals, long term repetition of specific activity is causative factor. b) The genome wide analysis revealed an association with the arylsulfatase G gene in WC but no specific \causative mutation within this gene has been identified⁸. c) The hypothesis of maladaptive neuroplasticity related to excessive, repetitive exercise of a learned activity has been proposed. Spending long time repeatedly on a specific task is one of main risk factor for this type of focal dystonia. Both the abnormal cortical inhibition and altered neuronal plasticity were found in subjects with task specific hand dystonia⁹. d) Recent studies indicate that cerebellar dysfunction may also be involved in the pathophysiology of writer's cramp although a large body of evidence points to the role of basal ganglia dysfunction. Modulation of sensorimotor plasticity of the primary cortex occurs as a result of sensorimotor adaptation influenced by the cerebellum. Building up an incorrect program to specific adaptation tasks such as writing can occur due to loss of cerebellar control over sensorimotor plasticity.^{10,11} e) Stress does not directly cause dystonia, but stressors like exams, timed writing and anxiety associated with these can contribute to writer's cramp¹². Recovery from focal dystonia considered to be difficult due to motor dysfunction which results in an imbalance both of group muscles i.e. agonist and antagonist while movement and relatively low, ranging from 3 to 7/1000,000 , from times this type of disorder is scary, due to persistent pain, impaired work, difficulty in activities, the decrease of self-esteem and socioeconomic commitment¹¹.

There was different treatment strategies used over past years such as oral medications including anticholinergic drugs and benzodiazepine, botulinum toxin injection under medical treatment. Limb immobilization is used for the treatment of FHD¹². A therapy such as body awareness is to make the patient understand and recognize the cause of the problem or body awareness with postural correction added splinting with specific exercises i.e. Active and passive ROM for the elbow, wrist and finger joints enhances stability of the scapular girdle and thus, improves the fine movement of the hand¹¹. Exercises after relaxation therapy which includes air-conditioned environment, listening to instrumental music, low illumination and lying on a bed for complete relaxation and stretching which contributes to the improvement of dystonic disorders in the affected area¹³. Activities carried out like draw circles on a paper holding the pen between the thumb and the index finger, maintaining the forearm elevated (without resting the elbow on the table). Then, the same exercise was made resting the elbow on the table¹¹. Writing practice was to help patient recognize the difference between writing on a paper which use of distal extremity whereas writing on a blackboard which uses of more proximal extremity which helps in awareness of grip force, muscle tension and it's also built the relationship of each body segment with each other¹⁴. Motor retraining and Sensory motor relearning program can prove useful in adapting the use dependent cortical alterations of the brain produced modification of brain activity demonstrated by fMRI. Training with games i.e. domino, checkers helps to stimulate motor concentration and coordination. Modified pen grip and handwriting training caused a clear reduction of writing pressure and grip force; also decreases pain and impairment in patients with WC¹⁴. Myorelaxing techniques (stretching, corrective postures) in order to neutralize their excessive pathological activity and to break down the dystonic attitude and tremors¹⁵. Finger dexterity exercises prepare the patient to use the necessary muscles involved in drawing and writing and progression consists of switching from cursive controlled handwriting to a more fluid and personal handwriting in a way from slow and finally obtaining the fast handwriting the patient needs in daily living¹⁶. Non-invasive stimulation such Transcranial direct stimulation was shown to enhance the response to rehabilitation in patients with musician's dystonia^{12,17}. Furthermore, anodal transcranial direct current stimulation targeting the cerebellum produced improvement of handwriting in patients with WC^{12,18}. Recent studies have confirmed the efficiency of certain physiotherapy approaches such as a modified pen grip, sensory training and EMG biofeedback^{19,20,21}. Brain surgery includes lesionectomy and more recently deep brain stimulation of ventralis oralis nucleus of thalamus^{22,23}. with the literature mentioned but there is paucity of literature on focal arm dystonia on symptomatic approach hence the need of the study to see the efficiency of conditioning based physiotherapy protocol for focal arm dystonia on 4 weeks of intervention.

II. METHODOLOGY

A. History

A 21 years old medical student visiting OPD with complaint of difficulty in writing and right hand muscle twitching of index finger & inability and pain while writing for long time having NPRS score (while writing): 5/10 since 2 months. Patient had environmental history of continuing writing for prolonged periods in the last 2 months following which he started having dystonic movements of the index finger that kept on increasing and currently unable to write more than 5 letters. On observation: writing speed and style was assessed by using stop watch: twitching of index finger of right hand on every 4-5 words. On Palpation: trigger points present over wrist extensors muscle; On bilateral upper limb examination a) tone: normal+2; b) reflex examination: +2 normal; sensation examination: superficial, deep and cortical were intact; MMT: shoulder 5/5, elbow 5/5 and wrist 4/5, hand functions: prehension and grasp function were intact. Investigations: motor and sensory nerve conduction studies shown normal findings and F wave also shows normal findings.

B. OUTCOME MEASURES

- Arm Dystonia Disability Scale: To assess impairment related to ADL i.e. writing, playing musical instrument, buttoning, handling utensils and feeding, hygiene, grasping objects and housework or outside job; with scoring from 0-3 in scale of 0 to 100% with 100% representing no disability 24
- State trait anxiety inventory: In this assessment scale the total score is of 160, higher the score indicates greater the anxiety.²⁵
- Die wellenschlagen hod observation analysis of writing^{13,26}:
- ✓ Duration: In this patient was asked to write given a sentence "die wellenschlagen hod" for 10 times as fast as he could. Time required to complete the task was noted.
- ✓ Quality of hand writing was observed for pre and post writings.

III. INTERVENTION

Targeted Muscles: Forearm Pronators and Supinators; Wrist Flexors and Extensors; Intrinsic hand Muscles, duration: Daily, 60 min session for 4 weeks.

A. FOCAL ARM DYSTONIA PROTOCOL

➤ FLEXIBILITY

- Stretching of Wrist Flexors:
Sit on a chair with back straight or stand erect. Maintain the shoulder in 90 flexion, and elbow in extension, then pull the wrist and fingers into extension.

Dosage- 30 seconds hold x 5 repetitions

- Stretching of wrist extensors:
Sit on a chair with back straight or stand erect. Maintain the shoulder in 90 flexion, and elbow in extension, then pull the wrist and fingers into flexion.

Dosage- 30 seconds hold x 5 repetitions.

➤ *TENDON GLIDING EXERCISES*

Note: Sit on a chair with back supported. Start with your fingers extended.

- Table top:
Bend all the fingers at the knuckles while keep the interphalangeal joints straight. Make a “L” shape.
- Hook fist:
Start with your fingers straight. Bend the tips of your fingers into a hook, whilst keeping the knuckles straight. Fingertips should touch the pads of fingers.
- Straight fist:
Start with your fingers straight; Touch the base of palm. Bend knuckles and first finger joints.
- Full fist:
Start with your fingers straight; Make a full fist by bending all of the joints.
- Thumb curls:
Start with your fingers straight. Curl the thumb into the palm as far as possible then stretch it out as far as possible.

Dosage: Hold for 10 seconds x 10 repetitions.

➤ *STRENGTHENING OF WRIST MUSCLES*

Isometric exercises of fingers

- Sit on a chair with back supported. Hold onto a sheet of paper using pad to pad prehension; while the therapist applies resistance via pulling the paper away. For example- thumb-index finger, thumb- middle finger, thumb-ring finger and thumb-little finger.

Dosage- 5 seconds hold x 20 repetitions x 3 sets.

- Sit on a chair with back supported. Soft (yellow) Theraputty was used and the patient pinches and pulls the Theraputty with pad to pad prehension of all fingers. Ex-thumb-index finger, thumb- middle finger, etc.

Dosage- 10mins.

- Isometric finger extension:
Sit on a chair with back supported. Hand supported on a table. Elbow is flexed and forearm pronated. Ask to lift individual finger, therapist applies manual resistance.

Dosage- 5 seconds hold x 20 repetitions x 3 sets.

- Isometric finger flexion:
Sit on a chair. Hand supported on a table. Elbow flexed, forearm supinated and resting on a pillow. Ask to lift individual finger, therapist applies manual resistance.

Dosage- 5 seconds hold x 20 repetitions x 3 sets.

➤ *ISOTONIC EXERCISES OF WRIST*

- Wrist flexors:
Sit on a chair with back supported. Start by resting the arm beside the body, elbow flexed at 90 degrees, forearm in supination, wrist in extension. Hold 1 kg dumbbell in the hand and begin flexing and extending the wrist in a slow controlled manner.
- Wrist extensors:
Sit on a chair with back supported. Start by resting the arm beside the body, elbow flexed at 90 degrees, forearm in pronated, and wrist in flexion. Hold 1 kg dumbbell in the hand and begin extending and flexing the wrist in a slow controlled manner.

Dosage: 10 repetitions x 3 sets.

➤ *PROGRESSION OF THE STRENGTHENING PROTOCOL (after 2 weeks)*

- Thera-putty exercises were progressed by using a Blue (Firm) theraputty.
- Isotonic exercises were progressed to training with 2.5 kgs.

➤ *MYOFASCIAL RELEASE TECHNIQUES OF WRIST MUSCLES*

- Passive Myofascial technique:
Sit on a chair the back supported. Hand is placed on pillow. Therapist locates the trigger points and performs myofascial release with aquasonic gel as medium. Dosage: 5-7 minutes
- Active Myofascial technique:
Patient position standing, bend forward towards the table, foam roller is placed on the table, therapist locates the trigger points and asks patient to roll his hand onto the foam roller.

Dosage: 3 minutes.

➤ *AEROBIC TRAINING*

Treadmill walking: Patient is trained at 60%-80% of Training Heart Rate; treadmill training is done for 20 minutes including the warm up and cool down period.

Note: Start with 60% of THR for first two weeks and gradually progressed to 80% of THR.

➤ *HOME EXERCISE PROGRAM:*

- Self-Foam rolling as a part of the home exercise programme.
- Practicing timed writing of 2 pages with a wide grip pen.
- Mitchell's Progressive Muscle Relaxation Technique using a standardized audio clip, done that lasted for 10 mins.

B. FIGURES OF FOCAL ARM DYSTONIA PROTOCOL



Fig. 1: Flexibility exercises of wrist



Fig. 2: Tendon gliding exercises



Fig. 3: Isometric exercises of fingers



Fig. 4: Isotonic exercises of wrist



Fig. 5: Progression of the strengthening protocol (after 2 weeks) i.e. Thera putty



Fig. 6: Myofascial release techniques of wrist muscles (active)

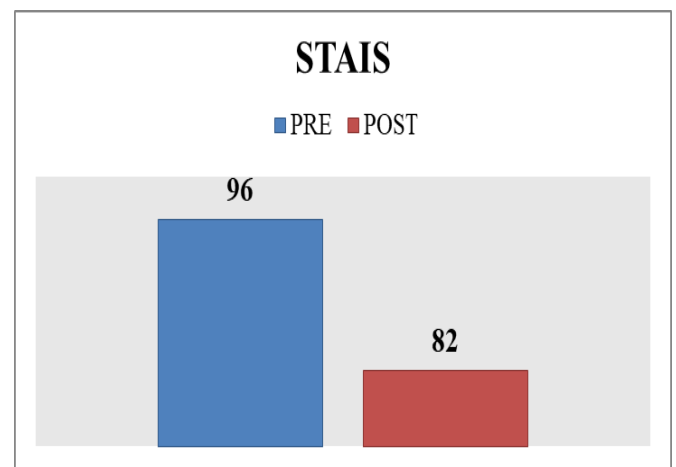
IV. DATA ANALYSIS AND RESULTS

A. Tables, Graphs and Figures.

Table 1: pre & POST of state trait anxiety inventory scale (STAIS)

SCALE	PRE	POST
STAIS	96/160	82/160

Inference: The above table shows significant reduction in scores that suggest a reduction in anxiety levels post the 4 week intervention.



Graph 1: PRE & POST of State trait anxiety inventory scale (STAIS)

Inference: In above graph shows significant reduction in scores that suggest a reduction in anxiety levels post the 4 weeks of intervention.

Table 2: PRE & POST of Arm Dystonia Disability scale (ADDS)

SCALE	PRE	POST
ADDS	0.72	0.36

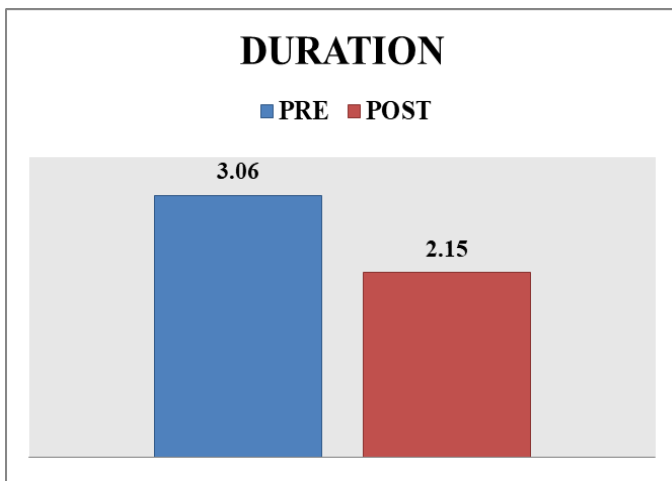
V. DISCUSSION

Inference: The above table shows significant reduction in dystonia related disability post the 4 weeks of intervention.

Table 3: PRE & POST observation analysis of writing a) Duration i.e. “die wellenschlagen hod”

Observation analysis of writing	PRE	POST
Duration	3minutes 6seconds	2minutes 15seconds

Inference: The above table shows that there is a significant improvement in writing speed post the intervention.



Graph 2: PRE & POST observation analysis of writing a) duration “die wellenschlagen hod”

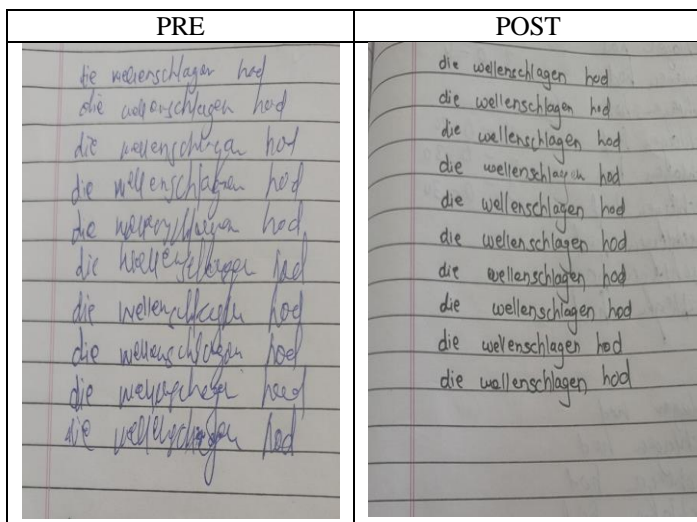


Fig 7: PRE & POST observation analysis of writing a) quality of hand writing i.e. “die wellenschlagen hod”

Interpretation: The above pictures show the pre and post differences in the quality and legibility of handwriting during the “ die wellenschlagen hod writing test”.

The following case report is the first condition based physiotherapy program on focal arm dystonia study to evaluate the efficiency of its clinical symptoms. The end results of the study shown improvement on outcome measures when compare to pre and post. In focal arm dystonia patients usually present with difficulty in writing, painful muscle cramps and spasms or sometimes affected forearm have tremor or hand whilst while writing, abnormal posturing but there were no abnormality in other activities involving the same muscle groups^{1,2,3,4}. In current study as the patient having difficulty in writing more than 5 letters and having muscle twitching movements of index finger and clinical assessment findings were trigger points over extensor group muscles of wrist and anxiety. On mentioned findings we designed and planned a rehabilitation program in which there is an improvement explained on symptom muscle spasm which is improved by myofascial techniques i.e. both active and passive , helps in mobilizing the soft tissue and helps in regain the length of its muscle tissue²⁷; whereas on improvement with outcomes such as in Arm dystonia disability scale (ADDS) which as component’s such as writing, activities of daily living, etc. the possible explanation could be because on flexibility training there is improvement range of motion, increases power, and reduced fatigue, promote circulation, increase energy , improve relaxation and stress relief whereas on strength training i.e. isotonic and isometric induces muscular contraction and size of skeletal muscle¹³. Benefits of strengthening exercises are decrease in muscle fatigue level and increases energy level²⁶. On state trait anxiety inventory scale (STAIS) there is improvement on anxiety of the patient and it’s because of relaxation which as positive impact on reduction of tension in the muscles and induced anxiety with respect with activity²⁸ whereas on aerobic exercise is a kind of sports designed to improve the basic quality of individuals, strengthen the nervous system, and regulate emotional ability, and it is also a long time, planned, and regular low-intensity exercise, which can have a positive impact on the individual’s cognition, emotion, and behaviour, which in turn helps to reduce anxiety²⁹. Finally comes to observation analysis of pre and post of duration and quality of writing, also shown improved by tendon gliding exercise allow each tendon to reach its greatest amount of range , by this finger movements were maintain as they are necessary for ADL activity such as writing. These exercise not only increase blood supplies, it also helps in release tension on the muscle, improve flexibility and prevent muscle fatigue while writing³⁰. The above mechanism condition physiotherapy program have shown significant improved on patients symptoms and also improved with daily activity of living.

VI. LIMITATIONS

It is single case study, evaluating on large population can helping in identifying more features of the condition.

It is short duration study i.e. 4 weeks, follow up of study is not done and by evaluating for longer duration of

the study will help to know the long term benefits of this condition symptomatic program.

VII. CONCLUSION

The following conditioning based symptomatic physiotherapy program of focal arm dystonia, which described to show improvement in all clinical features of the condition such as pain, disability, trigger points, anxiety and also with improvement seen on speed and quality of writing.

- **CONFLICT OF INTEREST:** None declared.

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