DOI: 10.52229/pjpt.v5i3.1747

EFFECTS OF SENSORIMOTOR RETRAINING IN ADDITION TO CONVENTIONAL PHYSICAL THERAPY ON PAIN, INVOLUNTARY CONTRACTIONS AND CRAMPS IN FOCAL HAND DYSTONIA PATIENTS: A RANDOMIZED CONTROLLED TRIAL

Asma Abbas[1*], Zarqa Sharif[2]

[1*]Physical Therapy Department, Iqra Medical Complex, Lahore, Pakistan
[2]Physical Therapy Department, Superior University, Lahore, Pakistan

HIGHLIGHTS

ABSTRACT

Dystonia is characterized by abnormally prolonged postures and decreased motor control due to the antagonist's muscle co-contraction and overflow to extraneous muscles. Retraining the brain to move more effectively is one approach to addressing movement dysfunction caused by task-specific focal hand dystonia.

OBJECTIVE: To compare the effects of sensorimotor retraining with conventional physical therapy on pain, involuntary contractions and cramps in focal hand dystonia patients

MATERIAL & METHODS: It was a randomized controlled trial conducted on 34 patients, equally divided into the sensorimotor retraining and the conventional groups. The study was completed in nine months after the approval of synopsis from ethical committee. The patients included were of both genders, aged 18 to 40 years, diagnosed with focal hand dystonia independently by two neurologists and handwriting score of four on the Fahn-Tolosa-Marin tremor rating scale. The outcomes were assessed for pain, involuntary movements and cramps. The continuous variables were presented as mean and standard deviation. The categorical variables were presented as frequency and percentage.

RESULTS: Fahn-Tolosa-Marin grades at baseline, at weeks 6 and 12 found to be 2.76±0.66, 1.71±0.59, 1.24±0.66 in the experimental group and 2.53±0.62, 2.06±0.24 and 1.71±0.47 in the conventional group, for visual analogue scale cramps at baseline, week 6 and 12 it found to be 70±5.66, 60.29±5.88 and 49.65±5.90 in the experimental group and 70.29±5.81, 63.35±5.96 and 55.24±6.12 in other groups respectively. There was a significant difference in all post-interventional assessments in favor of the experimental group ($p<0.000$) except for dystonia and visual analogue scale cramps at intermediate evaluation ($p=0.0701$ and 0.142).

CONCLUSION: This study concluded that there was a significant improvement in pain and involuntary movements, while dystonia and cramping improved equally in both groups without a significant difference at week 6. However, there was a significant improvement in pain, dystonia, involuntary movement and cramping score at week 12.

KEYWORDS: sensorimotor retraining; involuntary contractions; cramps; focal hand dystonia

Corresponding Author: Asma Abbas, Iqra Medical Complex, Lahore, Pakistan
Email: asimaabbas@icloud.com

CITATIONS: Abbas A, Sharif Z. Effects of sensorimotor retraining in addition to conventional physical therapy on pain, involuntary contractions and cramps in focal hand dystonia patients: a randomized controlled trial. Pakistan Journal of Physical Therapy. **2022; 5(3):16-23.**

INTRODUCTION

Dystonia is characterized by abnormally prolonged postures and decreased motor control due to the antagonist's muscle co-contraction and

DOI: 10.52229/pjpt.v5i3.1747

overflow to extraneous muscles. There are many different types of symptoms that can occur. They can be widespread and affect muscle groups all over the body, focal and localized to a specific area, such as the face or neck, or isolated to a single leg. Even though the pathophysiology of dystonia is still unknown, certain key concepts are emerging.[1-3]

The current understanding of dystonia comes from the study of focal hand dystonia, a perplexing variety of conditions that have been the subject of significant scientific investigation for the better part of two decades. Hand dystonia, also known as focused hand dystonia (FHD), is a term used to describe a group of task-specific illnesses that include writer's cramp, musician's dystonia, and a variety of other occupational hand dystonia. Furthermore, the problem may be generalized across tasks, and dystonia may be present even when the person is sleeping. It has been discovered to be receptive to examination due to its limited symptomatology.[4-7]

Because of its association with skilled manual labor, it has got the interest of researchers as a possible model illness for studying the underlying processes of hand function, particularly in the elderly population. Modern neuroimaging, electrophysiological, and psychophysical approaches have made significant contributions to our understanding of the disease's pathophysiology and treatment options. Neuroscientists have discovered that the nervous system is plagued by a wide range of issues, with the most consistent studies indicating that the most prevalent issues are a lack of inhibitory mechanisms, inappropriate sensorimotor processing, and maladaptive plasticity.[8,9]

Predisposing factors, such as heredity and sexual orientation, are also significant concerns. These triggering factors may interact and influence the development of dystonia. cervical dystonia, which causes the neck to twist or tilt when the head is moved, musician's dystonia, and cervical dystonia are all examples of concentrated dystonia. Some of the conditions that can affect the eyelids include writer's dystonia, blepharo-spasm bilateral, involuntary, synchronous, forceful eye closure, and spasmodic dystonia.[10-12]

Muscle spasms because of writing work-related dystonia is a task-specific focal dystonia that primarily affects adults and is characterized by abnormal upper-limb motions or posture caused by ineffective muscle contractions that interfere with writing tasks. This type of focal dystonia, known as writing cramps, is related to the act of writing and is the most common type of focal primary dystonia disorder seen in the general population. One of the most common symptoms is an overly tight grip when writing, which is followed by increasing difficulties with the activity over time. Severe muscular spasms may occur proximally, resulting in arm abduction in this situation. It was once thought to be caused by psychosis, but it is now recognized as a type of dystonia that manifests as sensory impairment with impaired spatial awareness, as well as motor abnormalities, among other symptoms. that has been formalized According to the scientific community, task-specific focal dystonia is caused by a combination of individual susceptibility and environmental factors.[13-15]

Even though more research is needed, there is evidence that risk factors for task-specific dystonia, which includes work-related dystonia, exist in both European and American populations.

Focused dystonia (also known as hand dystonia) is a type of dystonia that affects the hands and is thought to affect 0.5 to 1% of all musicians. Individually, these figures vary significantly depending on the instrument and the amount of labor required for each performance, as demonstrated by the distinction between a rhythm guitarist and a soloist guitarist.[16-18]

DOI: 10.52229/pjpt.v5i3.1747

This study has combined standard physical therapy and sensorimotor retraining to see if a combination of standard physical therapy and sensorimotor retraining is more effective in treating dystonia and aberrant contractions while also reducing pain and spasms than traditional physiotherapy intervention alone. When treating focal hand dystonia, a treatment plan that includes both sensorimotor retraining and finger splinting is used in the belief that, depending on the protocol used, plastic changes are either accelerated or prevented. This belief is supported by research. Based on the findings of abnormally increased plasticity in this patient group, a sensorimotor training program with splints may be more beneficial in people with FHD.

Based on previous research that demonstrated improvement in task-specific performance in people with FHD following sensorimotor retention, as well as positive clinical changes from a prolonged intervention protocol, we hypothesized that sensorimotor training SMR would result in reduced dystonia symptoms and improved abnormal contraction pain and cramps when compared to traditional physiotherapy alone. Our findings supported this hypothesis. Sensorimotor retraining, in conjunction with standard physical therapy, may help people with focal hand dystonia deal with discomfort, involuntary contractions, and cramping, as well as the mechanisms that cause these things.

Butler, K., A. Sadnicka, et al. 2018 conducted a study that showed the feasibility of establishing and evaluating a combination sensory–motor task-specific dystonia rehabilitation program. Participants with dystonia as a writer or musicians were recruited from a movement disorder and hand therapy clinic, where they were tested and treated. Hand exercises were performed in various situations such as prone, supine, sitting, and standing. Sensorimotor organization and proprioceptive awareness were found to be improved. Interviews verified the intervention's acceptance.[12]

Berque P, Gray H, et al. 2010 conducted a study that included eight musicians who suffered from focal hand dystonia. The treatments included rigorous constraint-induced therapy as well as slow-paced motor control retraining. The frequency of abnormal movements scale (FAM), the change in metronome speed reached during motor control retraining, and two ordinal dystonia evaluation ratings were utilized to evaluate the results. According to the results, there was a significant decrease in the number of aberrant movements per second during an instrumental performance for 12 months. As a result of these results, it seems that a combination of constraint-induced therapy and specific motor control retraining may be a feasible treatment option for musicians with FHD.[18]

Most studies either involved a small number of people with upper limb dystonia or focused on specific subtypes of the illness, such as writer's cramp, musician's dystonia, or dystonia associated with Parkinson-related neuro-degenerative disorders. Although various research on the effects of botulinum toxin injections has been published, only a few have examined the effects of sensorimotor retraining in people with focal hand dystonia who do not have any neurodegenerative diseases.[13]

Existing research does not give conclusive evidence on whether treatments are more successful, when they should be started, or how long or intense they should be delivered. There are currently no specific guidelines in existence. The purpose of this randomized controlled study (RCT) was to compare the benefits of sensorimotor retraining vs typical physical therapy on pain, involuntary contractions and cramping in patients with focal hand dystonia.

MATERIAL AND METHODS

In this RCT data was collected from the physiotherapy department of Hamza Hospital Lahore. This study was completed nine months after the approval of the synopsis from a period of

DOI: 10.52229/pjpt.v5i3.1747

September 2021 to January 2022. Patients of both genders aged between 18 to 40 years old, with a diagnosis of FHD diagnosed independently by two neurologists, having cramps with a five score on the numeric rating scale, patients with marked two difficulties of the level at Arm Dystonia Disability Scale (ADDS) were included using non-probability *convenient* sampling.[19] The existence of another neurological disorder such as peripheral neuropathy or a musculoskeletal problem, which may affect hand function, patients suffering from any other neurological condition, such as a stroke or parkinsonism, ongoing therapy with botulinum toxin injections into the afflicted upper limb's muscles, hand treatment or physiotherapy during the previous 12 months were excluded.

The sample was collected by meeting the inclusion criteria in the patient population and an awareness note was spread to encourage the patient population and their friends and families to participate in the study. Patients were divided into two groups of 20 each. They were given assurance that all the groups in the study would have treatment evidence to be successful in their condition. Participants were informed about the aim of this study, which is to help recognize any advantage of combing two treatment approaches. The subjects who met the inclusion/exclusion criteria were randomly allocated into sensorimotor experimental group A and conventional group B, using computer-generated random numbers. The initial random allocation sequences had been stored in an inaccessible third location, with a copy available for use. Since later executors may become confused with the initial coding of A and B, the allocator must record the precise meaning of these codes to avoid any additional ambiguity.

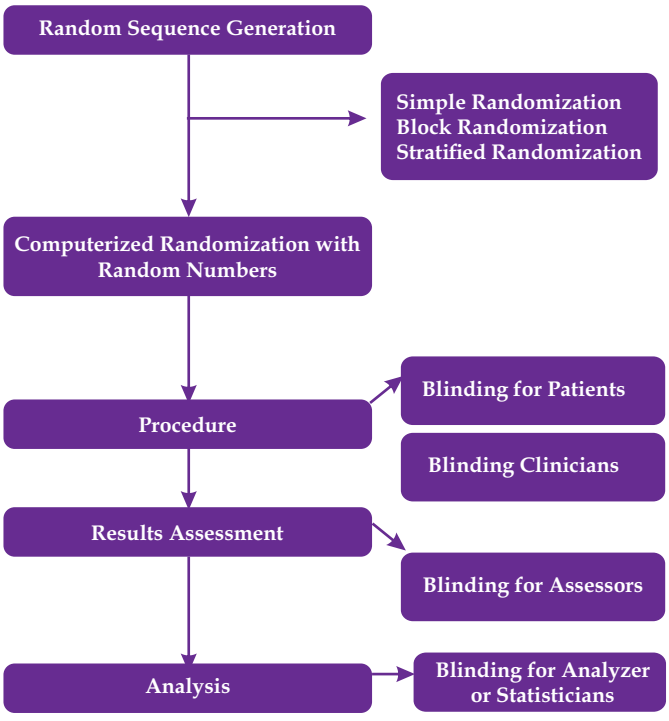

Figure 1: Randomization and Blindness

The study was single-blinded in which assessor was masked and blinded to the treatment given to both groups while the participants and clinicians were not maintained and remained blinded during the clinical trial. Data were collected at baseline and after six and twelve weeks of intervention.Changes in clinical outcomes variables pain, involuntary contractions, and cramps at baseline, 6 and 12 weeks were taken by using the visual analog scale for pain and Fahn-Tolosa-Marin Tremor Rating Scale. The duration of the treatment for the experimental group was 30 minutes a day and 5 days per week for 6 weeks and orthosis was worn one hour a day. The duration of the treatment for the conventional group was 45 minutes a day and 5 days per week for 6 weeks and orthosis was worn one hour a day. In experimental group, sensorimotor retraining and conventional physiotherapy were assigned. Conventional group B in which physiotherapy is given only. Data were analyzed using SPSS version 25 in which the continuous variables were presented as mean and standard deviation. The categorical variables were presented as frequency and percentage.

DOI: 10.52229/pjpt.v5i3.1747

RESULTS

The results showed mean and standard deviation for pain at baseline, at week 6 and 12 found to be 6.06±0.75 3±0.79 and 1.12±1.11 while in conventional group 6.12±0.93, 4.53±1.07 and 2.82±1.24. For Dystonia Scale at baseline, at week 6 and 12 found to be 6.06±0.75, 3±0.79 and 1.12±1.11 in the experimental group while in other group 63.47±1.81, 70.41±2.5 and 77.06±3. Fahn-Tolosa-Marin grades at baseline, at week 6 and 12 found to be 2.76±0.66, 1.71±0.59, 1.24±0.66 in the experimental group and 2.53±0.62, 2.06±0.24 and 1.71±0.47 in the conventional group, for visual analogue scale cramps at baseline, week 6 and 12 it found to be 70±5.66, 60.29±5.88 and 49.65±5.90 in the experimental group and 70.29±5.81, 63.35±5.96 and 55.24±6.12 in other group respectively. There was a significant difference in all post-interventional assessments in favor of the experimental group (p-value<0.000) except for dystonia and visual analogue scale cramps at intermediate evaluation, (p=.0701 and 0.142).

Table 1: Demographics

Variable	Mean	SD	P-Value
Age	32.35	5.72	0.78
Symptom Duration	5.29	1.53	0.09

The results regarding mean and standard deviation regarding age were found to be 32.35±5.72 in the experimental group and 30.47±4.09 in the conventional group while regarding onset it was found to be 5.29±1.53 in the experimental group and 5.12±1.58 in the conventional group.

Table 2: Outcome Measures in Both Groups

Outcomes Measures	Experimental	Conventional	P-Value
	Mean±S.D	Mean±S.D	
Pain at baseline	6.06±0.75	6.12±(0.928)	0.784
Pain at week 6	3±0.791	4.53±(1.068)	0.000
Pain at week 12	1.12±1.11	2.82±(1.237)	0.000
Dystonia scale at baseline	62.65±1.37	63.47±(1.807)	0.177
Dystonia scale at week 6	70.94±1.92	70.41±(2.501)	0.701
Dystonia scale at week 12	80.06±1.78	77.06±(3.01)	0.004
Fahn-Tolosa-Marin grades at baseline	2.76±0.66	2.53±(0.624)	0.284
Fahn-Tolosa-Marin grades at week 6	1.71±0.59	2.06±(0.243)	0.025
Fahn-Tolosa-Marin grades at week 12	1.24±0.66	1.71±(0.47)	0.029
VAS cramps baseline	70±5.66	70.29±(5.807)	0.882
VAS cramps at week 6	60.29±5.88	63.35±(5.958)	0.142
VAS cramps at week 12	49.65±5.91	55.24±(6.119)	0.011

DISCUSSION

Learning-based memory exercises, sensorimotor training, and task practice may all assist patients in increasing their capacity to do tasks. Individuals showed substantial improvement after getting training. Individuals who began an exercise plan were more likely to remain with it than those who did not. Those who followed the requirements improved more than their noncompliant colleagues. It took six months for the advantages in task-specific motor performance to vanish. Except for one, none of the patients achieved a complete recovery. Several factors contribute to the onset of dystonia.

People with dystonia are more likely to have changes in their job performance if they are motivated, cheerful, and able to handle stress and work demands, as well as if they have financial stability, family support, and are engaged in training. This preliminary research suggests a multifaceted strategy for retraining. When it comes to recovering after a training session, multifactorial training diminishes the capacity to recognize which training components are most significant. When the intervention takes place in a community or community-based setting, it becomes more difficult to retain control of the intervention.

Patients often work out three to five times a week. According to the results, people reported spending an average of 30 minutes per day on

DOI: 10.52229/pjpt.v5i3.1747

sensorimotor or task-specific training and another 30 minutes on LBSMT roughly five days a week. They also said that they have done some self-directed practice on their instrument. Even though this time commitment was less than suggested, the task-specific performance of both groups of people significantly improved as a result.

Self-care and community participation were critical issues for the majority of those who took part in this survey. Following the intervention, IND improved in the majority of patients, with 10 of 11 now functioning at or above the level of healthy peers (83%). Subjects in the dystonia study gained 10%. Depending on the circumstance and the person, objective task performance varied from 78 to 100%. This example shows how focal hand dystonia affects both sides of the body. Six months following the first interview, ten of the eleven people polled had returned to their previous jobs. Nine out of the eleven people who were questioned about their performance on the objective task were found to be performing at a level between 85 and 90 percent.[20,21]

Due to the lack of a control group, it is plausible that the Hawthorne effect resulted in an improvement in task performance because of the experiment (e.g., increased attention, increased understanding, improved awareness, more targeted rehabilitation activities, and increased awareness of the principles of retraining). Future studies must include, among other things, random assignment, blinded assessors, and supervised intervention at all stages of therapy (e.g., fitness programs, positive thinking, memory training, sensorimotor training, and task practice).[22]

This research must be long-term, with at least a year of follow-up. Given the established efficacy of 40 hours of training, it is recommended that the LBSMT be 40 hours long. It is feasible to mix physical activity with memory training to save training time (e.g., by walking on a treadmill or riding a bike). It would be easier to complete two occupations at the same time if activities could be integrated. As a result, the RCT results might be used in a real-world situation where phone conversations, online forums, and camera-supported workstations could be used to increase compliance.

CONCLUSION

This study concluded that there was a significant improvement in pain and involuntary movement while dystonia and cramping improved equally in both groups without significant difference at week 6, however there was a significant improvement in pain, dystonia, and involuntary movement, and cramping score at week 12. The results of the study should be disseminated among clinicians to help them decide on the choice of treatment plans for patients with stroke patients with early symptoms of dystonia and also be provided with sensorimotor integration to slow down and further reduce dystonia before it is getting complicated and advanced.

DECLARATIONS

Consent to participate: Written consent had been taken from patients. All methods were performed following the relevant guidelines and regulations.
Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.
Competing interests: None
Funding: No funding source is involved.
Authors' contributions: All authors read and approved the final manuscript.
CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

REFERENCES:

01- Malfait N, Sanger TD. Does dystonia always include co-contraction? A study of unconstrained reaching in children with primary and secondary dystonia. Exp Brain Res 2007; 176(2): 206-16.

DOI: 10.52229/pjpt.v5i3.1747

02- Murase N, Shimadu H, Urushihara R, Kaji R. Abnormal sensorimotor integration in hand dystonia. Suppl Clin Neurophysiol 2006; 59: 283-7.

03- Jabusch H-C, Altenmüller E. Epidemiology, phenomenology, and therapy of musician's cramp. 2006: 265-82.

04- Chen Q, Vu JP, Cisneros E, et al. Postural Directionality and Head Tremor in Cervical Dystonia. Tremor Other Hyperkinet Mov (N Y) 2020; 10: 10.7916/tohm.v0.745.

05- Hassell TJ, Phibbs FT. 14 Dystonia: Evaluation, Imaging and Medical Treatment. Functional Neurosurgery: The Essentials 2019: 8.

06- Ospina-García N, Cervantes-Arriaga A, Rodríguez-Violante M. Dystonia: Etiology, phenomenology, classification and treatment. Revista Mexicana de Neurociencia 2018; 19(4): 94-107.

07- Miller KC. The Evolution of Exercise-Associated Muscle Cramp Research. ACSM's Health & Fitness Journal 2018; 22(4): 6-8.

08- Pekmezović T, Ivanović N, Svetel M, et al. Prevalence of primary late-onset focal dystonia in the Belgrade population. Mov Disord 2003; 18(11): 1389-92.

09- Priori A, Pesenti A, Cappellari A, Scarlato G, Barbieri S. Limb immobilization for the treatment of focal occupational dystonia. Neurology 2001; 57(3): 405-9.

10- Ganos C, Ferre ER, Marotta A, et al. Cortical inhibitory function in cervical dystonia. 2018; 129(2): 466-72.

11- Chen X, Liu F, Yan Z, et al. Therapeutic effects of sensory input training on motor function rehabilitation after stroke. Medicine (Baltimore) 2018; 97(48): e13387-e.

12- Butler K, Sadnicka A, Freeman J, et al. Sensory–motor rehabilitation therapy for task-specific focal hand dystonia: A feasibility study. Hand Therapy 2018; 23: 175899831876421.

13- Pirio Richardson S, Altenmüller E, Alter K, et al. Research Priorities in Limb and Task-Specific Dystonias. Frontiers in Neurology 2017; 8(170).

14- Lozeron P, Poujois A, Meppiel E, et al. Inhibitory rTMS applied on somatosensory cortex in Wilson's disease patients with hand dystonia. J Neural Transm 2017; 124(10): 1161-70.

15- Alfradique-Dunham I, Jankovic J. Available treatment options for dystonia. Expert Opinion on Orphan Drugs 2017; 5(9): 707-16.

16- Pandey S. A practical approach to management of focal hand dystonia. Ann Indian Acad Neurol 2015; 18(2): 146-53.

17- Chang FCF, Frucht SJ. Motor and Sensory Dysfunction in Musician's Dystonia. Curr Neuropharmacol 2013; 11(1): 41-7.

18- Berque P, Gray H, Harkness C, McFadyen A. A combination of constraint-induced therapy and motor control retraining in the treatment of focal hand dystonia in musicians. Med Probl Perform Art 2010; 25(4): 149-61.

19- Yoshida K. Development and Validation of a Disease-Specific Oromandibular Dystonia Rating Scale (OMDRS). Frontiers in Neurology 2020; 11(1253).

20- Nowak DA. Disturbances of grip force behaviour in focal hand dystonia: evidence

DOI: 10.52229/pjpt.v5i3.1747

for a generalised impairment of sensory-motor integration? Journal of Neurology, Neurosurgery & Psychiatry 2005; 76(7): 953-9.

21- Candia V. Changing the Brain through Therapy for Musicians' Hand Dystonia. Annals of the New York Academy of Sciences 2005; 1060(1): 335-42.

22- Erro R, Rocchi L, Antelmi E, et al. High frequency somatosensory stimulation in dystonia: Evidence fordefective inhibitory plasticity. 2018; 33(12): 1902-9.