DOI: 10.55735/hjprs. v3i2.110

THE HEALER
Journal of Physiotherapy & Rehabilitation Sciences

Original Article

Effects of Functional Electrical Stimulation with and without Kinesiotherapy on Pain, Range of Motion and Quality of Life in Patients with Cervical Dystonia; A Randomized Clinical Trial

Mehak Imtiaz[1], Asna Waseem[2*], Maida Chaudhary[3], Aisha Sultan[4], Nouman Abid[5], Dua Shahzad[2]

[1]University Institute of Physical Therapy, The University of Lahore, Lahore, Pakistan
[2]Department of Physical Therapy, Central Park Medical College, Lahore, Pakistan*
[3]Physiotherapy Department, Hamza Hospital, Lahore, Pakistan
[4]Physiotherapy Department, PhysioCare Pain relief and Rehabilitation Center, Lahore, Pakistan
[5]Physiotherapy Department, Lifeline health care and pain center, Lahore, Pakistan

ABSTRACT

Background: Cervical dystonia is characterized by cervical muscles contracting involuntarily which eventually leads to uncomfortable and awkward postures of the head and neck and compromised motor control. **Objective:** To compare the effects of functional electrical stimulation with and without kinesiotherapy on pain, range of motion, functional disability and quality of life in patients with cervical dystonia. **Methods:** This controlled trial conducted at the University of Lahore Teaching Hospital, Lahore. About 84 patients with cervical dystonia were recruited in this study using non-probability convenient sampling. Patients suffering from cervical dystonia aged between 30 and 50 years were randomly allocated into two groups with 42 patients in each group. The control group was treated with functional electrical stimulation and routine physical therapy while the experimental group was treated with functional electrical stimulation also with kinesiotherapy and routine physical therapy. Both the groups were evaluated and assessed using the Toronto western spasmodic torticollis rating scale, the numeric pain rating scale, the 36-item short-form health survey, the neck disability index and the range of motion were measured using a universal goniometer. After checking the normality of the data which was assessed by the Kolmogorov- Smirnov test within group comparison repeated measured ANOVA was used to compare the variables at baseline, then the 8th week and then the 16th week. For the comparison between the groups' an independent sample t-test was used and $p<0.05$ was deliberated as significant. **Results:** Functional electrical stimulation combined with the kinesiotherapy group showed more improvement in the experimental group as compared to the control group. The mean values displayed that there was a statistically significant difference in different variables between both groups. When the scores at baseline and16th week for Toronto western spasmodic torticollis rating scale for both the groups were compared and it showed a statistical difference between both the groups ($p<0.05$). **Conclusion:** This trial concludes that kinesiotherapy along with functional electrical stimulation with routine physical therapy is more effective and beneficial than functional electrical therapy with routine physical therapy alone, in reducing pain, improving range of motion, functional disability and quality of life in patients having cervical dystonia.

DOI: 10.55735/hjprs. v3i2.110

Access the article online

SCAN ME

***Corresponding Author:** Asna Waseem, Central Park Medical College, Lahore, Pakistan
Email: asna_waseem@yahoo.com
Keywords: cervical dystonia; functional electrical stimulation; kinesiotherapy; pain; range of motion; quality of life

Citations: Imtiaz M, Waseem A, Chaudhary M, Sultan A, Abid N, Shahzad D. Effects of functional electrical stimulation with and without kinesiotherapy on pain, range of motion and quality of life in patients with cervical dystonia; A randomized clinical trial. The Healer Journal of Physiotherapy and Rehabilitation Sciences. 2023;3(2):349-359.

INTRODUCTION

Cervical dystonia is characterized by the cervical muscles involuntarily contracting which leads to uncomfortable and awkward postures of the neck and head and also compromised motor control with simultaneous stimulation of both antagonist and agonist muscles, this is the most common form of focal dystonia. These dystonic movements might fluctuate conferring different postures, activities or errands which occasionally might lead to immobile dystonic postures.[1] Even though the motor indexes are most prominent, some somatosensory discernment insufficiencies are also observed in dystonic patients.[2,3] Functional electrical stimulation (FES) is a source used by the physical therapist that enables the electrical stimulation of a muscle that is dispossessed of the normal control to produce a functionally beneficial contraction again.

It consists of the transmission of functional electrical signals to the muscles hence facilitating the movement.[2,4] Then this stimulus depolarizes the motor nerve, generating a very synchronous response in all the motor units of the muscle which was stimulated.[5] Its contrivance of working is very closely related to the enablement of the physiological mechanism of striated muscles, which eventually allows selective and monotonous afferent participation to the central nervous system, which not only activates the localized muscles but also activates the reflex contrivances that necessary for reconstructing and reorganizing the motor activity.[6] Kinesiotherapy is the treatment used by the physical therapist which combats the imbalance between muscles and ligaments and helps to develop the muscular groups which are necessary to maintain the correct postures. The aims of kinesiotherapy include; avoiding and stopping the evolution of scoliosis, increases of spinal mobility, strengthening the spinal muscles, adjustment of the physiological attitude and posture and attenuation secondary body asymmetries.[7] Kinesiotherapy includes different types of therapeutic exercises, such as strengthening (isokinetic, isotonic and isometric), stretching, and aerobic exercises.[8] The symptom of pain deserves a lot of attention because it is directly associated with the physical and emotional well-being, to performance of an individual and the achievement of activities of daily living as well as the quality of life (QOL).

Considering this, kinesiotherapy performed after surgical procedures is crucial to prevent and managing the symptom of pain. Performing early kinesiotherapy with stretching, active-free and actively resisted exercises for the upper extremity aids in preventing and managing the symptom of pain, being an essential tool to recreate physical functioning and labor, social and functional reinsertion of patients with cervical dystonia. [9] Cervical dystonia is a type of focal dystonia that is characterized by neck muscles contracting involuntarily, which ultimately leads to an awkward and disabling abnormal head posture. It has a huge influence on the quality of life and activities of daily living of the sufferer.[10,11] It is the type of dystonia that involves the neck muscles. Although it is not

DOI: 10.55735/hjprs. v3i2.110

the only cause of limitation in rotating the neck while torticollis might be the cause.[12] The symptoms of cervical dystonia can get worse for almost 3 to 5 years. Some common factors which lead to the worsening of the symptoms are fatigue, emotional stress and physical activities. It is more commonly defined as spasmodic torticollis and it is not related to alterations in the central and peripheral nervous system, but it might also be due to any muscle, bone or joint pathology. Cervical dystonia might be considered an important health issue with a devastating influence on all levels of functioning like the capacity to work and quality of sleep.

Because of adapting awkward postures, cervical dystonia mostly gives its victims a blemished appearance which is then accompanied by embarrassment and might lead to social averting and isolation. A higher rate of prevalence of anxiety and depression has also been testified in patients with cervical dystonia.[13] Cervical dystonia is also accompanied by numerous emotional and physical factors that can substantially influence a sufferer's QOL. Not only the pain and awkward head and neck posture decreases the patients' life satisfaction but also truncated self-confidence level, embarrassment, anxiety, depression and inadequate societal interaction also play a key role in decreasing patients' life satisfaction.[14]

By combining both interventions for these patients might play a positive role in enhancing and improving their life satisfaction levels. It has been recommended that in addition to follow-up of symptoms of cervical dystonia, these patients should also be evaluated for psychiatric indications on repetitive clinical checkups as well.[15] Future researchers are recommended to conduct clinical trials to assess these symptoms to move towards a better understanding of the functioning of the brain and improved treatments for this disease.[16] Physical therapy treatment has shown low to moderate effects on the motor symptoms of cervical dystonia. Combining kinesiotherapy with functional electrical stimulation might add to the literature concerning physical therapy treatment of cervical dystonia.[17] While talking about the terms of psychiatric illnesses which accompany cervical dystonia, it is recommended that interventions that aim at treating depression and anxiety might have a larger influence on improving patients with cervical dystonia's QOL.[18] Formerly several studies reported showing improvement in range of motion, pain, QOL and functional disability among patients of cervical dystonia. Rather insufficient literature was available regarding the comparison of FES and kinesiotherapy among cervical dystonia patients. Hence, this current study aimed to find out the effectiveness of FES combined with kinesiotherapy.

An optimistic outcome of this current study might lead to developing treatment guidelines that might be incorporated into neurological rehabilitation. Psychiatric comorbidity is extremely prevalent and is a substantial prognosticator of compromised QOL in cervical dystonia patients rather than the severity of dystonia motor symptoms.[19] The findings of this current study supported the theory of collective neurobiology for motor and non-motor features and also highlight the need for systematic research concerning psychiatric disorders in patients with dystonia. After finding out that FES and kinesiotherapy combined can do wonders in patients with cervical dystonia this could be incorporated into their interventional regime

METHODS

In this randomized controlled trial, 84 patients were recruited in this study from the outpatient clinic of the department of physical therapy, the University of Lahore Teaching hospital, Lahore. Considering the level of confidence to be 95%, the predictable mean change in the neck disability index in group A= 28.2[14], the predictable mean change in the neck disability index in Group B= 20[14], the predictable standard deviation in group A= 9.8, the predictable standard deviation in

DOI: 10.55735/hjprs. v3i2.110

Group B= 14, the expected sample size in each group= 35. After adding 20% drop out 35+7= 42 in each group.[19] The sample size was calculated using open epitool software was 70 patients with cervical dystonia with 35 patients in each group, by using the following formula $n=2\delta^2 (z_{1-\alpha/2} + z_{1-\beta})^2/(\mu_1-\mu_2)^2$. After adding 20% drop out, the final sample size was estimated to be 84, with 42 participants in each group. All these patients were indiscriminately recruited into 2 groups, 42 patients in each group. (Figure-I) The control group which was group A was treated with FES without kinesiotherapy and routine physical therapy while the experimental group which was group B was treated with FES with kinesiotherapy combined with routine physical therapy.

The trial protocol of this current study was approved by the ethical board of the University of Lahore, Teaching Hospital. No participant left the trial during the entire study. 94 patients with cervical dystonia were assessed for eligibility and 10 were excluded (six did not meet the eligibility criteria while four declined to participate in this study. Patients with the presence of cervical dystonia aged between 30 and 50[20,21] years were recruited in this study. Both genders, patients with complaints of cervical dystonia for at least one month and patients who had no additional disorders of the neck were included in this current study.

Printed consent forms were given to every patient to sign for their consent. Patients with a previous history of orthopedic disorders affecting the upper extremity and cervical spine, conventional treatment of cervical disc herniation and patients with the presence of degenerative and inflammatory processes of the musculoskeletal system were excluded from this study.[22] The outcome measures were pain, range of motion, quality of life and functional disability. To assess pain numeric pain rating scale (NPRS) was used. The patient rated his/ her pain on a scale from zero to ten.[23] To assess a range of motion universal goniometer[24] was employed. To assess the quality of life, The 36-item short-form health survey[25] was used. The Toronto Western Spasmodic Torticollis Rating Scale[26] was used to assess the severity of cervical dystonia and then the success of its treatment. The neck disability index could be rated as a raw score or can be doubled and can also be expressed as a percentage.[27] All the patients went through a detailed screening examination and were assessed for eligibility criteria. Inclusion and exclusion criteria were strictly followed for the recruitment of participants in this study. They were recruited after giving their informed consent. The outcome assessor which was the physical therapist was completely unaware of the group allocation.

All the patients signed a written informed consent form and approval was sought from the Ethical Committee of the University of Lahore, Lahore, Pakistan. All the patients were assessed at the baseline, re-assessed after 8 weeks of the treatment and then re-assessed again after 16 weeks of treatment by the same physical therapist assessor. The assessor physical therapist found out that the patients were highly motivated by the end of the treatment. The patients were allotted randomly into two equal groups. The patients were randomized into two groups using computer-generated random numbers.

The treatment plan was provided at the physical therapy department of the University of Lahore, Lahore for 6 days per week on daily basis for the first 8 weeks of the trial then 4 days per week on alternate days for the rest of the weeks of the trial. The detailed screening examination and the pre and post-assessments of the outcome measures and the interventions were performed by different physical therapists as assessors. Since both the groups were required to receive FES[28], it was made practical with the use of an electrical stimulator. Four surface electrodes were positioned over non-dystonic cervical muscles that have antagonist actions. Electrical stimulations were harmonized, with two channels operated instantaneously using

DOI: 10.55735/hjprs. v3i2.110

the on and off, rise and decay ramps.

The considerations of the functional electrical stimulators were set at frequency 50Hz, 10 seconds on time, 30 seconds off time that is one ratio three on and off ratio, 2 seconds rise time and 2 second decay time and pulse of 200 µs. Each FES session for both groups lasted for 30 minutes.[2] Group B which was the experimental group was additionally treated by kinesiotherapy and the sessions possessed definite and advanced exercises for both cervical and trunk muscles for patients with cervical dystonia.[29] It aimed to lessen discomfort and pain and to increase mobility. Manual soft tissue mobilization of the scalene and trapezius also aided the patient in controlling the dystonic movements of the neck thus resulting in reduced localized pain and discomfort.

The experiment group received sessions that comprised active rotations of the cervical and trunk which were combined with flexion and extension movements which were estimated to be 10 degrees of range of motion to allow the reticence of the dystonic movements. The session started with four repetitions of each exercise and then the number of repetitions was gradually increased until the patient could perform fifteen repetitions deprived of the stimulus of the dystonic movements.[30]

Each time the patient maintained his or her performance for three sessions, the number of repetitions was increased and five or more repetitions were added to the series. The physical therapist recommended resisted cervical and trunk rotations of about twenty degrees to both sides and performed rhythmical stabilization of the scapula and upper extremities (proprioceptive neuromuscular facilitation). The kinesiotherapy exercise techniques also included cervical stretching, active and passive cervical mobilization and pumping. Every session was for about twenty- five minutes. It also included various kinds of remedial activities as well as extending, fortifying; isotonic, isokinetic, isometric and high-impact work out depending on patients' capabilities. The chin Tuck is one of the best postural activities for fighting neck torment. It is a jaw-fold workout and this exercise was also included in the session. Since both groups were also supposed to be treated by routine physical therapy[31] interventions as well. They included soft tissue mobilization, relaxation exercises and general simple exercises of the neck.

No particular format was provided concerning the intensity and frequency of the sessions of the routine physical therapy. Patients in both groups were asked to perform these exercises daily at home, five repetitions for every exercise were recommended. Statistical Package of Social Sciences version 23 was used to enter the data and then analyze the data for computing the results. The qualitative variables, functional disability and quality of life were represented in the form of percentage and frequency while the quantitative variables like pain and range of motion were represented in the form of mean and standard deviation.

After checking the normality of the data which was assessed by the Kolmogorov-Smirnov test within group comparison repeated measured ANOVA was used to compare the variables at baseline, then the 8th week and then the 16th week. For the comparison between the groups' an independent sample t-test was used and $p<0.05$ was deliberated as significant.

RESULTS

The results of descriptive statistics of age showed us that the mean and deviation for group A (control group) was 43.11 ± 5.05 while for group B (experimental group) was 44.47 ± 5.27 (Table-I).

DISCUSSION

The current randomized controlled trial aimed at finding out the effects of functional electrical stimulation combined with

DOI: 10.55735/hjprs. v3i2.110

Table I: Means of Age in Both Groups

Study Groups	n	Minimum	Maximum	Mean ±S.D
Group A	42	32.0	50.0	43.11±5.05
Group B	42	33.0	50.0	44.47±5.27

Table II: Within-group Comparison for Pain Intensity in Both Groups

Study Groups		Mean	Standard Deviation	p-value
Group A	Baseline	8.38	1.04	0.000
	After 8 weeks	6.90	1.14	
	After 16 weeks	5.98	1.28	
Group B	Baseline	8.67	1.03	0.000
	After 8 weeks	4.83	1.08	
	After 16 weeks	0.98	2.74	

Table III: Between-group Comparison for Different Variables (n=42)

Variables		Study Groups	Mean	Standard Deviation	p-value
Numeric Pain Rating Scale	At Baseline	Group A	8.74	1.04	0.75
		Group B	8.67	1.03	
	After 8 weeks	Group A	6.90	1.14	0.000
		Group B	4.83	1.08	
	After 16 weeks	Group A	5.98	1.28	0.000
		Group B	0.98	0.84	
Toronto Western Spasmodic Torticollis Rating Scale	At baseline	Group A	75.1429	5.92	0.56
		Group B	74.3095	7.13	
	After 8 weeks	Group A	48.5000	6.29	0.000
		Group B	35.6190	7.79	
	After 16 weeks	Group A	27.2381	5.55	0.000
		Group B	6.5714	1.31	
Quality of Life	At baseline	Group A	21.90	3.52	0.901
		Group B	21.81	3.44	
	After 8 weeks	Group A	34.26	7.67	0.000
		Group B	46.21	5.13	
	After 16 weeks	Group A	56.8333	7.98143	0.000
		Group B	74.9048	7.42379	

DOI: 10.55735/hjprs. v3i2.110

kinesiotherapy on patients suffering from cervical dystonia. The demographic and clinical characteristics of the patients recruited in both groups were quite similar which showed us that both groups were comparable. The results of the current study showed us that FES combined with kinesiotherapy along with routine physical therapy is an effective treatment when compared to functional electrical stimulation with routine physical therapy alone.

This trial was of the patients who were affected by cervical dystonia and then who were evaluated through Toronto Western Spasmodic Torticollis Rating Scale, Numeric Pain Rating Scale and The 36- item Short Form Health Survey. This trial showed the influence of a novel and new rehabilitation program which provided kinesiotherapy and functional electrical stimulation together. This current study describes the positive results of FES with routine physical therapy along with kinesiotherapy (passive, active and resisted movements and stretching of the neck). Patients suffering from cervical dystonia have several other infirmities but in this current study, the rehabilitation program concentrated explicitly on muscle weakness, quality of life, restricted range of motion of the neck, pain and functional disability.

The patients who completed the kinesiotherapy plan along with functional electrical stimulation along with routine physical therapy showed improvements in pain, the rigorousness of the ailment and quality of life when compared with the patients who only received treatment consisting of functional electrical stimulation and routine physical therapy only. A very important aspect of cervical dystonia is insufficient muscle relaxation which eventually leads to an immobile dystonic posture and limits the range of motion.[31] This compromised relaxation of the muscles might be triggered by enlarged activity of agonist and antagonistic muscles or might be due to the reduction in voluntary and consecutive movements. [32] Hence, this current study managed to propose an interventional plan which included kinesiotherapy which includes the tissue release techniques that help to recover the quality of life of patients with protracted cervical dystonia. A case study was conducted by Queiroz [2] and W Hu[33] and their coworkers to find out the effects of botulinum toxin combined with physical therapy treatment versus botulinum toxin alone.

Their treatment plan of combining functional electrical therapy with kinesiotherapy coincides with our treatment plan. They compared the two groups using Toronto Western Spasmodic Torticollis Rating Scale and the Short Form Health Survey which were also the tools employed in our current study. Their results showed us that there was an improvement in the disease severity within both groups however, the group which received physical therapy intervention reported a rather significant decrease in the severity of pain and disability. This shows us that even though botulinum Injections are highly effective, the results also show that by the addition of the physical therapy protocols, the patients showed improvement in all the outcome variables. Therefore, those patients who do not have access to regular injection treatment might proceed with the physical therapy protocols which they even can learn first with the help of a physical therapist and then can perform at home.

Several studies were conducted on cervical dystonia and its physical therapy treatment but mostly they did not include quality of life assessment in their analyses. Although Zetterberg[34] and his coworkers reported an improved QOL in 5 out of 6 patients, this improvement in them was entirely attributed to the physical therapy interventional regime, since none of the patients received botulinum injections for a minimum of 3 months before their admission in their study so there was no effect of botulinum injections from any of their preceding injections. This current trial is consistent with Zetterberg's findings, who found improvement in six out of 8 domains of 36-item short form health survey subscales in

DOI: 10.55735/hjprs. v3i2.110

the patients treated with physical therapy, though those who were treated with botulinum only did not report any improvement on any quality of life subscales. Smania[35] and her coworkers conducted a study that aimed at evaluating how cervical dystonia was influenced by two rehabilitative treatment programs, which were a standard biofeed back program and the novel physical therapy program which consists of passively elongating the myofascial cervical structures and postural re-education exercises.

Even after the end of the treatment plan, the reductions in disability and pain were still remarkable. These primary results recommend that physical therapy treatment programs which are proposed in their study and our current study might be very promising measures of interventions and methods of rehabilitation for cervical dystonia. In this current trial, the group A (FES and routine physical therapy only) and group B (functional electrical therapy combined with kinesiotherapy along with routine physical therapy) reported significant differences after the treatment was over.

The results of this current trial provided us with further evidence that patients with cervical dystonia might achieve significant benefits from using FES combined with kinesiotherapy and routine physical therapy altogether. This current trial was found significant because it not only showed us the effects of FES, kinesiotherapy and routine physical therapy altogether it has also evaluated the functional disability, QOL and activities of daily living of patients suffering from cervical dystonia. The experimental group which was treated by FES, kinesiotherapy and routine physical therapy showed more improvements concerning the domains of quality of life (functional and communal features), improvements in muscle strength and range of motion along with daily routine activities. This trial demonstrated to us the association of rehabilitative treatment programs which had a combination of kinesiotherapy and functional electrical stimulation increases the beneficial effect of both treatments.

In both groups, FES proved to be effective in controlling the symptoms of cervical dystonia, but with the addition of kinesiotherapy protocol, there was an additional significant decrease in the perceived pain and an improvement in the functioning of daily routine activities. The better mean total score of pain might be attributed to being a consequence of a more obvious reduction in muscle contraction and the abnormal posture adapted earlier. Guiding the patients, creating awareness among them and teaching the patients to how to manage their awkward posture and muscular contractions might help to avoid and prevent this condition in the future.

This can be achieved through kinesiotherapy, which might help to keep the levels of pain under control and thus reduce disability and improve the activities of daily living. However, this current study strongly suggests that combining the kinesiotherapy program with FES and routine physical therapy might represent a very valid approach that improves the symptoms. Nevertheless, future researchers are highly recommended to conduct additional high-quality trials in the future.

CONCLUSION

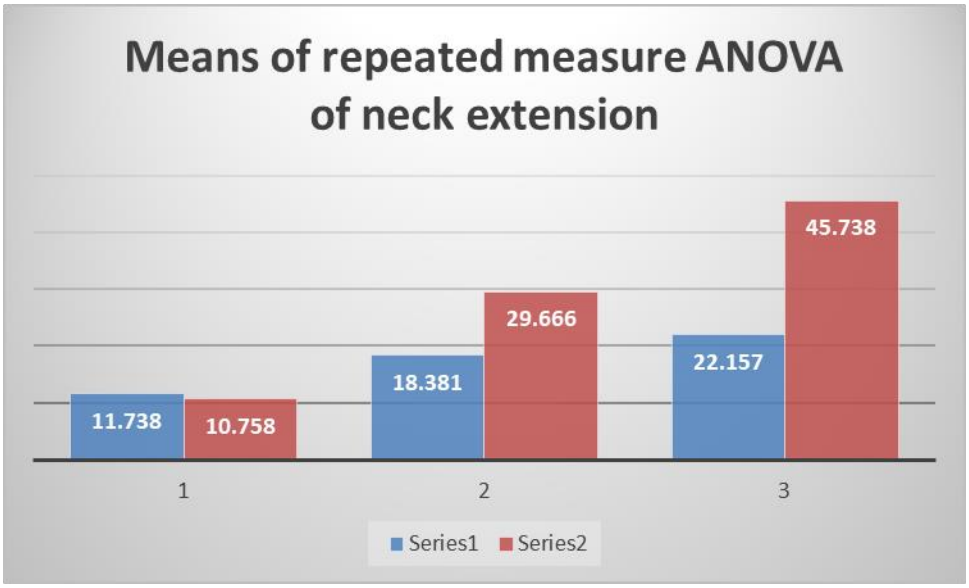
This current trial concludes that kinesiotherapy along with functional electrical stimulation with routine physical therapy is more effective and beneficial than functional electrical therapy with routine physical therapy alone, in reducing pain, improving range of motion, functional disability and quality of life in patients having cervical dystonia.

DECLARATIONS

Consent to participate: Written consent had been taken from patients. All methods were performed following the relevant guidelines and regulations.

DOI: 10.55735/hjprs. v3i2.110

Figure I: Figure of Means of Repeated Measure ANOVA of Range of Motion of Neck Extension



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

1. Camfield L, Ben-Shlomo Y, Warner TT, Group ESoDiEC. Impact of cervical dystonia on quality of life. Movement disorders 2002; 17(4): 838-41.
2. Queiroz MAR, Chien HF, Sekeff-Sallem FA, Barbosa ER. Physical therapy program for cervical dystonia: a study of 20 cases. Functional neurology 2012; 27(3): 187.
3. Ramdharry G. Physiotherapy cuts the dose of botulinum toxin. Physiotherapy Research International 2006; 11(2): 117-22.
4. Martins F, Guimarâes LT, Vitorino D, Souza L. Eficácia da eletroestimulação funcional na amplitude de movimento de dorsiflexão de hemiparéticos. Revista Neurociências 2004; 12(2): 103-9.
5. Soetanto D, Kuo C-Y, Babic D. Stabilization of human standing posture using functional neuromuscular stimulation. Journal of Biomechanics 2001; 34(12): 1589-97.
6. Modesto PC, Pinto FCG. Comparison of functional electrical stimulation associated with kinesiotherapy and kinesiotherapy alone in patients with hemiparesis during the subacute phase of ischemic cerebrovascular accident. Arquivos de neuro-psiquiatria 2013; 71: 244-8.
7. Carmen TO, Vladimir P, Consuela TA, Larisa P, Marius S. Use of kinesiotherapy means for the rehabilitation of the S-shaped scoliosis. Journal of Physical Education and Sport 2019; 19: 2309-14.
8. Mascarin NC, Vancini RL, Andrade MdS, Magalhães EdP, de Lira CAB, Coimbra IB. Effects of kinesiotherapy, ultrasound and electrotherapy in management of bilateral knee osteoarthritis: prospective clinical trial. BMC musculoskeletal disorders 2012; 13(1): 1-9.
9. Rett MT, Mesquita PdJ, Mendonça ARC, Moura DP, DeSantana JM. Kinesiotherapy decreases upper limb pain in females submitted to mastectomy or quadratectomy. Revista Dor 2012; 13: 201-7.

DOI: 10.55735/hjprs. v3i2.110

10. De Pauw J, Van der Velden K, Meirte J, et al. The effectiveness of physiotherapy for cervical dystonia: a systematic literature review. Journal of neurology 2014; 261(10): 1857-65.
11. Werner C, Loudovici-Krug D, Derlien S, et al. Study protocol: multimodal physiotherapy as an add-on treatment to botulinum neurotoxin type A therapy for patients with cervical dystonia: DysPT-multi—a prospective, multicentre, single-blind, randomized, controlled study. Trials 2021; 22(1): 1-9.
12. Velickovic M, Benabou R, Brin MF. Cervical dystonia. Drugs 2001; 61(13): 1921-43.
13. Fabbrini G, Berardelli I, Moretti G, et al. Psychiatric disorders in adult-onset focal dystonia: a case-control study. Movement Disorders 2010; 25(4): 459-65.
14. Mordin M, Masaquel C, Abbott C, Copley-Merriman C. Factors affecting the health-related quality of life of patients with cervical dystonia and impact of treatment with abobotulinumtoxinA (Dysport): results from a randomised, double-blind, placebo-controlled study. BMJ open 2014; 4(10): e005150.
15. Tomic S, Petkovic I, Pucic T, Resan B, Juric S, Rotim T. Cervical dystonia and quality of life. Acta Neurologica Belgica 2016; 116(4): 589-92.
16. Zurowski M, McDonald WM, Fox S, Marsh L. Psychiatric comorbidities in dystonia: emerging concepts. Movement Disorders 2013; 28(7): 914-20.
17. Konkiewitz EC, Trender-Gerhard I, Kamm C, et al. Service-based survey of dystonia in Munich. Neuroepidemiology 2002; 21(4): 202-6.
18. Ben-Shlomo Y, Camfield L, Warner T. What are the determinants of quality of life in people with cervical dystonia? Journal of Neurology, Neurosurgery & Psychiatry 2002; 72(5): 608-14.
19. Cramer H, Lauche R, Hohmann C, et al. Randomized-controlled trial comparing yoga and home-based exercise for chronic neck pain. The Clinical journal of pain 2013; 29(3): 216-23.
20. Group ESoDiEC. A prevalence study of primary dystonia in eight European countries. Journal of neurology 2000; 247: 787-92.
21. Crowner BE. Cervical dystonia: disease profile and clinical management. Physical therapy 2007; 87(11): 1511-26.
22. Toth E, Pesce A, Tartaglia G, Russo GM, Inghilleri M, Caruso R. The beneficial effect of physiotherapy on the cervical spine mobility of ACDF patients and healthy individuals: An original observational cohort comparison research protocol. Interdisciplinary Neurosurgery 2021; 24: 101058.
23. Kahl C, Cleland JA. Visual analogue scale, numeric pain rating scale and the McGill Pain Questionnaire: an overview of psychometric properties. Physical therapy reviews 2005; 10(2): 123-8.
24. Rome K, Cowieson F. A reliability study of the universal goniometer, fluid goniometer, and electrogoniometer for the measurement of ankle dorsiflexion. Foot & ankle international 1996; 17(1): 28-32.
25. Zhang Y, Bo Q, Lun S-s, Guo Y, Liu J. The 36-item short form health survey: reliability and validity in Chinese medical students. International journal of medical sciences 2012; 9(7): 521.
26. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. Journal of manipulative and physiological therapeutics 1991.
27. Peckham PH, Knutson JS. Functional electrical stimulation for neuromuscular applications. Annual review of biomedical engineering 2005; 7(1): 327-60.
28. Frey J, Hess CW, Kugler L, Wajid M, Wagle Shukla A. Transcranial Magnetic Stimulation in Tremor Syndromes: Pathophysiologic Insights and Therapeutic Role. Frontiers in Neurology 2021: 1482.
29. Voos MC, Oliveira TdP, Piemonte MEP, Barbosa ER. Case Report: Physical therapy management of axial dystonia. Physiotherapy Theory and Practice 2014; 30(1): 56-61.
30. Akhtar MW, Karimi H, Gilani SA. Effectiveness of core stabilization exercises

DOI: 10.55735/hjprs. v3i2.110

and routine exercise therapy in management of pain in chronic non-specific low back pain: A randomized controlled clinical trial. Pakistan journal of medical sciences 2017; 33(4): 1002.
31. Balint B, Mencacci NE, Valente EM, et al. Dystonia. Nature reviews Disease primers 2018; 4(1): 1-23.
32. Buccolieri A, Avanzino L, Marinelli L, Trompetto C, Marchese R, Abbruzzese G. Muscle relaxation is impaired in dystonia: a reaction time study. Movement disorders: official journal of the Movement Disorder Society 2004; 19(6): 681-7.
33. Hu W, Rundle-Gonzalez V, Kulkarni SJ, et al. A randomized study of botulinum toxin versus botulinum toxin plus physical therapy for treatment of cervical dystonia. Parkinsonism & related disorders 2019; 63: 195-8.
34. Zetterberg L, Halvorsen K, Färnstrand C, Aquilonius S-M, Lindmark B. Physiotherapy in cervical dystonia: six experimental single-case studies. Physiotherapy theory and practice 2008; 24(4): 275-90.
35. Smania N, Corato E, Tinazzi M, Montagnana B, Fiaschi A, Aglioti SM. The effect of two different rehabilitation treatments in cervical dystonia: preliminary results in four patients. Functional neurology 2003; 18(4): 219-26.