DOI: https://doi.org/10.54393/pbmj.v5i7.390

PAKISTAN BIOMEDICAL JOURNAL

https://www.pakistanbmj.com/journal/index.php/pbmj/index

Volume 5, Issue 7 (July 2022)

Original Article

Effects of Constraint-induced Movement Therapy on Hand and Arm Functions in Patients With Parkinson's Disease

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ARTICLE INFO

Key Words:

Exercise therapy, Hand, Neurological rehabilitation, Parkinson's disease, Upper extremity

How to Cite:

Ghazanfar, M. ., Abbas, M. ., Rafiq, S., Kalsoom, U. ., Muhammad Rizwan, Amin, T. ., Razzaq, A., & Sarwar, H. . (2022). EFFECTS OF CONSTRAINT-INDUCED MOVEMENT THERAPY ON HAND AND ARM FUNCTIONS IN PATIENTS WITH PARKINSON'S DISEASE: Constraint-Induced Movement Therapy in Patients with Parkinson's Disease. Pakistan BioMedical Journal, 5(7). https://doi.org/10.54393/pbmj.v5i7.390

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Received Date: 19th April, 2022
Acceptance Date: 18th July, 2022
Published Date: 31st July, 2022

ABSTRACT

Objective: The aim of this research was to ascertain the effect of constraint-induced movement therapy on individuals with Parkinson's disease's hand and arm functions. **Methods:** It was a randomized controlled experiment that ran from December 28, 2020, to March 3, 2021, at the physical therapy departments of the University of Lahore Teaching Hospital, Lahore General Hospital and Mayo Hospital. Between the ages of 50 and 80, 40 male and female Parkinson's disease patients were divided evenly into two groups. Patients in the experimental group (n = 20) received both routine physical treatment and constraint-induced movement therapy, while patients in the control group (n = 20) received just normal physical therapy. Six hours a day, for a total of four weeks, were spent treating the patients. Frenchay Arm Test was used to evaluate patients (FAT). The data were examined using IBM's Statistical Package for Social Sciences (SPSS) version 25. **Results:** Data for 40 individuals were evaluated, with 17 (42.5%) men and 23 (57.50%) women, and a mean age SD of 65.28 7.28 with a minimum age of 50 and a maximum age of 78. Patients improved in both groups; the mean difference between pre- and post-test results in the experimental group was 2.060.66 (p=0.000), whereas it was -0.940.64 (p=0.000) in the control group. Contrary to conventional physical therapy alone, however, patients reported greater improvement following treatment with constraint-induced movement therapy (p=0.003). **Conclusion:** According to this study, constraint-induced mobility therapy helped Parkinson's disease patients' hands and arms operate better.

INTRODUCTION

Parkinson's disease(PD) is one of the most prevalent conditions affecting the central nervous system. This condition results from the destruction of cells inside the mesencephalon in substantia nigra. Typically, it starts in between 58- 62 years of age; nevertheless, cases have indeed been identified in younger people [1,2]. Two out of three major axial symptoms are needed for clinical diagnosis of Parkinson's disease: bradykinesia, resting tremor, and rigidity [3,4]. In order to detect PD, bradykinesia should be evident [3]. There are also accounts of difficulty handling objects with sufficient speed and agility [5]. Upper extremity participation in PD generally corresponds to a deficit in the preparation and execution of both basic and complicated voluntary

DOI: https://doi.org/10.54393/pbmj.v5i7.390

movements, and also a lack of repeating fast motor polyarticular sequences due to disruption of dopaminergic pathway [6]. The number of PD patients have handwriting defects. Microgrphia is the handwriting abnormality that is most frequently identified and readily observable in PD [7]. Micrographia is a typical symptom of PD, which presents as either a constant or gradual decline of handwriting size or both [8]. Motor symptoms associated with Parkinson's disease (stiffness, bradykinesia, and tremor) cause three main changes in writing [9]: the size of writing [10] (micrographia [11]), pen-pressure [12], and kinematics. Typically, PD patients are unable to manage the pinch grip very effectively and have difficulty grasping small items because of the resting tremor. Bradykinesia usually effects motions, and most basic actions becomes challenging and cause consumption of time [13,14]. For this reason, CIMT is a very useful intervention. The upper extremity that is affected undergo intensive therapy by limiting the unaffected limb. This causes plasticity and cortical reorganization [15]. As constraint induced movement therapy has been an effective treatment for gross and fine motor performance of upper limb in patients with cerebral palsy [16], multiple sclerosis [17], stroke [18] and Parkinson disease [19]. There are many high-quality researches available regarding the effectiveness of CIMT especially in cerebral palsy and stroke [16,18]. In case of Parkinson's disease, there is not much available evidences regarding its effectiveness. The goal of this study was to give useful data to physicians, researchers, and the general public. This research helped to fill in the gaps left by prior studies in the field of neurorehabilitation. Clinicians and neurorehabilitation experts can employ the more effective procedure on patients to get greater results in less time. Patient choice is taken into account while treating patients, according to evidence-based practice. As a result, the patient will be able to determine which treatment is the most effective. The goal of this study was to see how constraint induced mobility therapy affected Parkinson's disease patients' hand and arm functions.

METHODS

From December 28, 2020 to March 3, 2021, a retrospectively registered, parallel planned, randomized controlled trial with disguised allocation was undertaken at the physiotherapy department of the University of Lahore Teaching Hospital, Lahore General Hospital, and Mayo Hospital in Lahore, Pakistan. The Research and Ethics Committee of Riphah International University, Lahore, Pakistan (REC/RCR & AHS/20/0214) accepted the study protocol, which was retrospectively filed in the US Clinical Trials Registry (NCT04818528) the study's goal was explained to patients who matched the qualifying requirements. The permission form was signed by all eligible individuals who consented to participate in the study. Prior to the randomization, the therapist determined eligibility. Following a baseline examination, eligible patients were allocated to one of two groups (experimental or control) in a 1:1 ratio. The study comprised both male and female individuals diagnosed with Parkinson's disease by a neurologist between the ages of 50 and 80. Patients with atypical Parkinsonism, Alzheimer's disease, antidepressants, or significant cognitive impairments were excluded from the study. Random number tables were used to assign participants to two groups in a concealed manner, as per CONSORT guidelines 2010. The experimental group received constraint induced movement therapy (CIMT) in addition to regular physical treatment, Compared to the control group, which just got routine physical therapy. Patients in the standard physical therapy group received care in accordance with clinical recommendations based on a systematic review, with an emphasis on improving aerobic capacity, engaging in muscular strengthening exercises, being able to walk, addressing postural and balance problems, and improving hand-arm function [20]. Three phases made up each session: Active phase (both standing and sitting): upper and lower limb motor control exercises; cool-down phase (sitting): respiratory exercises and mobilization. Warm-up: passive mobilization of main joints and lower limb muscle strengthening [21]. Throughout the research, the usual or baseline treatment was maintained. For four weeks, the experimental group received constraint induced mobility therapy. For four weeks, training was conducted for six hours each day, five days per week. All of the data was gathered utilizing a standardized Frenchay arm test questionnaire. Three components, or therapy packages, make up CIMT: Rough, graded training of the paretic upper extremity for up to 6 hours per day, 5 days per week, for 4 weeks is necessary to improve task-specific use of the injured limb (i.e., shaping where individuals are gradually trained for tasks that steadily increase in complexity). Restraints, often referred to as compelled use treatment, include putting the non-paretic upper extremity in a glove to force the use of the injured arm for 90% of the total number of awakened hours. Compliance gains through lifestyle interventions aimed at applying knowledge gained in the lab or hospital to patients' actual circumstances (i.e., a transfer package). Treatment was provided by a single therapist to eliminate bias. The Frenchay Arm Test was used to evaluate the patients at baseline and after four weeks. This test evaluated upper-limb proximal motor function and agility during daily activities in persons with upper-limb impairments caused by neurological diseases. FAT is a metric for upper-limb activity limitation. The FAT

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scale is a two-point ordinal scale (0-1). If you fail, you get a zero, and if you pass, you get a one [22]. The IBM statistical software for social sciences (SPSS) version 25 was used to examine the data. Because the sample size was 50, the Shapiro-Wilk Test was utilized. The data was not considered normally distributed since the Shapiro-Wilk Test Sig. value was less than 0.05. The Wilcoxin signed rank test is used to examine how subjective and objective assessments vary over time. This is a matched group comparison test that is non-parametric. The non-parametric ManWhitney U test was performed to compare two groups at different intervals. Using an 80 percent confidence level and a 13 percent margin of error, a sample size of 40 patients (20 interventions and 20 control group) was chosen, with an estimated percentage of improvement in the intervention group [23]. Value of $p < 0.05$ was considered statistically significant.

RESULTS

Forty-nine Parkinson's disease patients were assessed for eligibility, out of which 40 participants met the inclusion criteria and were subsequently enrolled in the study. Nine patients were excluded because (n=2) declined to participate because they were from different cities and unable to come consecutively. While (n=3) were considering for surgery, (n=2) were on unstable dopaminergic dose and (n=2) were unable to comprehend the therapist instructions. Forty eligible participants were randomly allocated into experimental group (n=20) and control group (n=20). Table 1 shows baseline characteristics of the participants in both groups. Eight male and twelve female participants were in experimental group with mean (SD) age of 68.25(7.43). While in the control group there were nine males and eleven female participants with mean(SD)age of 64.30(7.39).

Characteristics	Exp (n = 20)	Con (n = 20)
Age (years), Mean (SD)	68.25±7.43	64.30±7.39
Gender, n (%)		
Male	8 (40.00%)	9 (45.00%)
Female	12 (60.00%)	11 (55.00%)
Tremors, n (%)	20 (100%)	20 (100%)
Unilateral Tremors	7 (35%)	6 (30%)
Bilateral Tremors	13 (65%)	14 (70%)
Exp: Experimental group, Con: Control group		

Table 1: Baseline characteristics of participants

Figure 1 shows that in experimental group (n=1) patient moved to another city therefore unable to follow up and (n=2) discontinued intervention because of prevalent COVID-19 situation. While in control group two patients were drop out because 1 patient became COVID-19 positive and other patient undergo brain surgery.

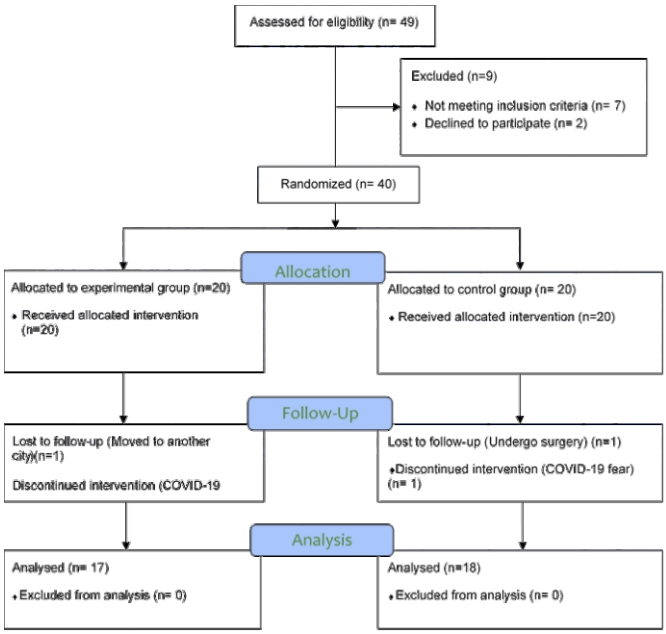

Figure 1: CONSORT flow diagram

Table 2 shows that mean±SD of pre values of FAT was 2.40±0.99 in experimental group (CIMT+RPT), and 2.50±0.83 in control group (RPT) and post values were 4.47±0.62 and 3.56±0.92. Mean difference of experimental group was -2.06±0.66 and of control group was -0.94±0.64. Results between both the groups were significant and the p-value was 0.003.

Outcome	Groups				Difference within Groups		Difference between Groups	
	Week 0		Week 4		Week 4		Week 0	Week 4
FAT	Exp (n = 20)	Exp (n = 20)	Exp (n = 17)	Con (n = 18)	Exp Z (p-value)	Con Z (p-value)	Z (p-value)	Z (p-value)
	2.40 (0.99)	2.40 (0.99)	4.47 (0.62)	3.56 (0.92)	-3.72 (0.000)*	-3.49 (0.000)*	-0.55 (0.584)	-2.96 (0.003)*

Exp: Experimental group, Con: Control group, FAT: Frenchay Arm Test, (*): p-value <0.05: Significant

Table 2: Statistics of Frenchay Arm Test. Mean (SD) of groups, Wilcoxon Signed Ranks test within groups, and Mann-Whitney U Test between groups.

DISCUSSION

Forty participants were divided into two equal groups. Participants in experimental group received constraint induced movement therapy by use of mitt on less affected arm to enhance the use of more affected arm. Participants also undergo routine physical therapy for upper limb in both groups. This study reports that the although the hand and arm functions improves in both groups but the CIMT group was superior to the routine physical therapy group, as the statistical mean difference was present. These findings are also supported by the literature. A past study shows that the modified constraint induced movement therapy improve fine and gross motor functions of upper extremity

DOI: https://doi.org/10.54393/pbmj.v5i7.390

in PD patients [19]. Although that study used the modified version of constraint induced movement therapy, which is less intensive, but the literature has shown that type of CIMT, intensity and duration does not alter the outcome [24]. Another study suggested that the modified CIMT can improve timing performance of upper limb in PD patients [25]. The improvement in upper limb functions is may be due to the increase number of glial cells derived neurotrophic factors (GDNF) which can derive neuroplasticity. As on study PD rat models suggested that after CIMT the levels of GDNF increases which promote dopamine level [26]. In contrast to our findings, a study suggested that CIMT did not improve upper extremity functions in PD patients, and therefore does not look to beneficial [27]. But their findings were preliminary and were based on a very small sample size of 6 PD patients and also, they provided treatment for 2 weeks only. Therefore, their results are in contrast to the findings of our study and have less generalizability. In other neurological population, CIMT has been strongly recommend for use in rehabilitation settings, especially in the stroke [28] and cerebral palsy [29], but the role of CIMT in Parkinson's disease is less understood and no definite clinical guidance was found. As CIMT has been found promising in improving upper limb functions in different neurological population, this study also supports the use of CIMT for PD patients. Neuroplasticity derive change can make changes for much longer and can contribute towards prolonged betterment instead of short-term benefit. Understanding of the underlying mechanism is essential. As one rat model study pointed out that increase in GNDP levels promote dopamine level. Thus, CIMT training not only provide the therapeutic effects in returns of intensive exercise training but also the neurophysiological changes that can persist for much longer. But yet, the PD is the progressive neurological disorder, therefore, the continuous use of exercise is important for retaining the effects of training. Unlike many other neurological disorders, Parkinson's disease tends to severe over time and may lead to fluctuation in medicine dose and even surgery. Therefore, adjustment in therapy according to patient need may yield better results and follow ups are necessary to improve quality of life. In a previous study it has been found that after strength training of the upper extremity, the power generation of the limb increases but failed to improve the quality of life of PD patients [30]. But CIMT may seems to be promising in improving quality of life in patients, as the patient uses his/her affected hand for 6 hours a day in different tasks may yield better learning and performance thus helping in ADL and improving quality of life.

CONCLUSION

Constraint induced movement therapy is effective in managing Parkinson's disease patients.

REFERENCES

[1] Elbaz A, Carcaillon L, Kab S, Moisan F. Epidemiology of Parkinson's disease. Revue Neurologique (Paris). 2016 Jan; 172(1):14-26. doi: 10.1016/j. neurol. 2015.09.012.

[2] Youdim MB, Kupershmidt L, Amit T, Weinreb O. Promises of novel multi-target neuroprotective and neurorestorative drugs for Parkinson's disease. Parkinsonism Related Disorder. 2014 Jan; 20 Suppl 1:S132-6. doi: 10.1016/S1353-8020(13)70032-4.

[3] Błaszczyk JW. Parkinson's Disease and Neurodegeneration: GABA-Collapse Hypothesis. Frontiers in neuroscience.2016 Jun; 10:269. doi: 10.3389/fnins.2016.00269.

[4] Sveinbjornsdottir S. The clinical symptoms of Parkinson's disease. Journal of neurochemistry. 2016 Oct; 139 Suppl 1:318-324. doi: 10.1111/jnc.13691.

[5] Proud EL, Miller KJ, Bilney B, Balachandran S, McGinley JL, Morris ME. Evaluation of measures of upper limb functioning and disability in people with Parkinson disease: a systematic review. Archives of Physical Medicine and Rehabilitation. 2015 Mar; 96(3):540-551.e1. doi: 10.1016/j.apmr.2014.09.016.

[6] Fundarò C, Cavalieri C, Pinna GD, Giardini A, Mancini F, Casale R. Upper Limb Interactive Weightless Technology-Aided Intervention and Assessment Picks Out Motor Skills Improvement in Parkinson's Disease: A Pilot Study. Frontiers in Neurology. 2020 Feb; 11:40. doi: 10.3389/fneur.2020.00040.

[7] Thomas M, Lenka A, Kumar Pal P. Handwriting Analysis in Parkinson's Disease: Current Status and Future Directions. Movement Disorders Clinical Practice 2017 Nov; 4(6):806-818. doi: 10.1002/ mdc3.12552.

[8] Wu T, Zhang J, Hallett M, Feng T, Hou Y, Chan P. Neural correlates underlying micrographia in Parkinson's disease. Brain. 2016 Jan; 139(Pt 1):144-60. doi: 10.1093/brain/awv319.

[9] Zham P, Arjunan SP, Raghav S, Kumar DK. Efficacy of Guided Spiral Drawing in the Classification of Parkinson's Disease. IEEE journal of biomedical and health informatics. 2017 Oct; 22(5):1648-1652. doi: 10.1109/JBHI.2017.2762008.

[10] Potgieser AR, Roosma E, Beudel M, de Jong BM. The Effect of Visual Feedback on Writing Size in Parkinson's Disease. Parkinsons Disoder 2015 Jun; 2015:857041. doi: 10.1155/2015/857041.

[11] Drotár P, Mekyska J, Rektorová I, Masarová L, Smékal Z, Faundez-Zanuy M. Evaluation of handwriting kinematics and pressure for differential diagnosis of Parkinson's disease. Artificial intelligence in

DOI: https://doi.org/10.54393/pbmj.v5i7.390

medicine. 2016 Feb; 67:39-46. doi: 10.1016/j.artmed .2016.01.004.

[12] Letanneux A, Danna J, Velay JL, Viallet F, Pinto S. From micrographia to Parkinson's disease dysgraphia. Movement Disorders. 2014 Oct; 29(12):1467-75. doi: 10.1002/mds.25990.

[13] Cikajlo I, Pogačnik M. Movement analysis of pick-and-place virtual reality exergaming in patients with Parkinson's disease. Technol Health Care. 2020 Jan; 28(4):391-402. doi: 10.3233/THC-191700.

[14] Yu NY, Van Gemmert AWA, Chang SH. Characterization of graphomotor functions in individuals with Parkinson's disease and essential tremor. Behavior research methods. 2017 Jun; 49(3):913-922. doi: 10.3758/s13428-016-0752-y.

[15] Sethy D, Bajpai P, Kujur ES, Mohakud K, Sahoo S. Effectiveness of modified constraint induced movement therapy and bilateral arm training on upper extremity function after chronic stroke: A comparative study. Open Journal of Therapy and Rehabilitation. 2016 Feb 15;4(1):1-9. doi.org/ 10.4236/ojtr.2016.41001

[16] Eliasson A-C, Nordstrand L, Ek L, Lennartsson F, Sjöstrand L, Tedroff K, et al. The effectiveness of baby-CIMT in infants younger than 12 months with clinical signs of unilateral-cerebral palsy; an explorative study with randomized design. Research in developmental disabilities. 2018 Jan;72:191-201. doi.org/10.1016/j.ridd.2017.11.006

[17] Mark VW, Taub E, Uswatte G, Morris DM, Cutter GR, Adams TL, et al. Phase II randomized controlled trial of constraint-induced movement therapy in multiple sclerosis. Part 1: effects on real-world function. Neurorehabilitation and neural repair. 2018 Mar ;32(3):223-32. doi.org/10.1177/1545968318761050

[18] Hatem SM, Saussez G, della Faille M, Prist V, Zhang X, Dispa D, et al. Rehabilitation of motor function after stroke: a multiple systematic review focused on techniques to stimulate upper extremity recovery. Frontiers in human neuroscience. 2016 Sep; 10:442. doi.org/10.3389/fnhum.2016.00442

[19] Lee K-S, Lee W-H, Hwang S. Modified constraint-induced movement therapy improves fine and gross motor performance of the upper limb in Parkinson disease. American journal of physical medicine & rehabilitation. 2011 May; 90(5):380-6. doi.org/ 10.1097/PHM.0b013e31820b15cd

[20] Mak MK, Wong-Yu IS, Shen X, Chung CL. Long-term effects of exercise and physical therapy in people with Parkinson disease. Nature Reviews Neurology. 2017 Nov; 13(11):689-703. doi.org/10.1038/ nrneurol.2017.128

[21] Pazzaglia C, Imbimbo I, Tranchita E, Minganti C, Ricciardi D, Lo Monaco R, et al. Comparison of virtual reality rehabilitation and conventional rehabilitation in Parkinson's disease: a randomised controlled trial. Physiotherapy. 2020 Mar; 106:36-42. doi.org/10.1016/j.physio.2019.12.007

[22] Opara J, Małecki A, Małecka E, Socha T. Motor assessment in Parkinsons disease. Annals of Agricultural and Environmental Medicine. 2017 Sep; 24(3):411-5. doi.org/10.5604/12321966.1232774

[23] Dettmers C, Teske U, Hamzei F, Uswatte G, Taub E, Weiller C. Distributed form of constraint-induced movement therapy improves functional outcome and quality of life after stroke. Archives of Physical Medicine and Rehabilitation. 2005 Feb; 86(2):204-9. doi.org/10.1016/j.apmr.2004.05.007

[24] Kwakkel G, Veerbeek JM, van Wegen EEH, Wolf SL. Constraint-induced movement therapy after stroke. The Lancet Neurology. 2015 Feb; 14(2):224-34. doi.org/10.1016/S1474-4422(14)70160-7

[25] Hwang S-J, Hong Y-J, Yoo I-G, Jeon H-S. Modified constraint-Induced Movement Therapy (CIMT) for the Elderly With Parkinson's Disease: A Preliminary Study. Physical Therapy Korea. 2009; 16(1):70-8.

[26] Huagn Y, Zhang S, Ren X, Zhang J. The effects of constraint-induced movement therapy on expression of tyrosine hydroxylase and glial cell derived neurotrophic factor in Parkinson's disease model rats. Chinese Journal of Physical Medicine and Rehabilitation. 2012; 34(1):8-11.

[27] Tuite P, Anderson N, Konczak J. Constraint-induced movement therapy in Parkinson's disease. Movement disorders: official journal of the Movement Disorder Society. 2005 Jul; 20(7):910-1. doi.org/10.1002/ mds.20528

[28] Etoom M, Hawamdeh M, Hawamdeh Z, Alwardat M, Giordani L, Bacciu S, et al. Constraint-induced movement therapy as a rehabilitation intervention for upper extremity in stroke patients: systematic review and meta-analysis. International Journal of Rehabilitation Research. 2016 Sep; 39(3):197-210. doi.org/10.1097/MRR.0000000000000169

[29] Hoare BJ, Wallen MA, Thorley MN, Jackman ML, Carey LM, Imms C. Constraint-induced movement therapy in children with unilateral cerebral palsy. The Cochrane database of systematic reviews. 2019 Apr; 4(4):Cd004149. doi.org/10.1002/14651858.CD00 4149.pub3

[30] Correa TV, da Silva Rocha Paz T, Allodi S, de Britto VLS, Correa CL. Progressive muscle-strength protocol for the functionality of upper limbs and quality of life in individuals with Parkinson's disease: Pilot study. Complementary Therapies in Medicine. 2020 Aug; 52:102432.doi.org /10.1016/j.ctim.2020.102432