Effectiveness of Tele Rehabilitation on Manual Dexterity and its Impact on Quality of Life in Patients with Parkinson's Disease: A Pilot Study

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Abstract

Background: Patients with Parkinson's disease exhibit disturbed manual dexterity. This impairment leads to difficulties in activities of daily living, such as buttoning a shirt or hand-writing. Recent advances in telecommunication technologies have boosted the possibility to deliver rehabilitation via the internet (i.e. telerehabilitation). The aim of the present pilot study was to investigate the effectiveness of Tele Rehabilitation to improve manual dexterity and its impact on quality of life in patients with Parkinson's Disease.

Method: This study was based on Quasi-experimental design and Convenience sampling method was used in Older Adults with Parkinson's disease of 60 to 80 yrs age. The sample size is 10 (n=10) Experimental group (Tele Rehabilitation) (n=5) and Control group (resistance training) (n=5). The study was conducted at home for the patients referred from SRM hospital and Research centre. Screening was done using UPDRS and MoCA. Outcome measures were analysed using Purdue peg board test, Chedoke Arm and Hand Activity Inventory(CAHAI-13), Parkinson's Disease Questionaire-39(PDQ-39).

Results: The results revealed that the experimental group has shown significant difference at 5% level in all the metrics "Right, Left, Bi-manual, Assembly tasks of Purdue Peg Board test, CAHAI 13 and PDQ39. But comparing between the experimental and control groups significant difference at 5% level was observed only in bi manual task of Purdue Peg board test.

Conclusion: Task specific Tele rehabilitation-based dexterity program significantly improved fine motor skills in Parkinson's disease. Neuro Tele Rehabilitation is considered as an alternative effective mode of service delivery connecting the people in need with health care practitioners by providing effective interventions with minimal inconveniences.

Keywords: *Tele Rehabilitation, Manual dexterity, Resistance, Parkinson Disease,Technology,Quality of Life.*

Introduction

The most widely recognized neuro degenerative disorders is Parkinson's disease (PD). Geriatrics is the most common population with PD. More than 10 million people worldwide are living with Parkinson's Disease . With age the Parkinson's incidence increases and not to ignore, the individuals with PD are even diagnosed before age 50[1]. Though the peak age of onset is 70 years, PD begins between the ages of 40 and 70 years. There are incidences where people in their 30's and 40's developed PD even though it is primarily a disease of elderly[2].

Parkinson's disease is a chronic, persistent, long term, progressive neurodegenerative disease represented by both motor and non-motor characteristics and it is progressive and degenerative disease, it significantly impacts not only patients but also families and caregivers[1,2]. The progressive degeneration and destruction of dopamine- generating neurons in the substantia nigra, located within the basal ganglia is the most common result of the cardinal features of PD[3].

The cardinal motor features in PD,described as "classical triad" includes resting tremors, cog wheel rigidity and bradykinesia[4]. Tremors are the most observed

by the caregivers among the three cardinal features in PD patient The onset of tremors are more pronounced in older age patients above 64 years[5]. Bradykinesia is the second cardinal motor clinical of Parkinson's Disease . The third major cardinal feature of PD is rigidity. The rigidity of PD not only affects the extremities but also face, which is displayed as a "masked" expression (hypomimia)[6]. Postural instability is accounted as the fourth feature that usually occurs during the progression of the disease[7]. The performance of daily and functional activities is greatly hindered due to dexterity, postural stability and gait disturbances[6,8].

Dexterity is a motor skill which is learnt or developed through repeated repetition of motor learning[9]. Dexterity deficits affect the ability to perform functionally with the upper extremity like reaching, grasping and manipulating objects[10] and found to be a strong predictor of functional independence in activities of daily living[11]. Manual dexterity includes muscular, skeletal and neurological functions to produce small, precise movements[12]. Dexterity training is effective in increasing fine manual control during goal-directed movements and dexterity-related ADL[13]. Specific to Parkinson's 30 min home based dexterity training program (HOMEDEXT) for a month was proven effective in enhancing manual dexterity skills along with dexterity related ADL[14]. Though the usage of drugs is very effective in reducing motor symptoms, most of the clients are not aware of the possible adverse effects of the long usage of the drugs[15].

In the context of Parkinson's disease, the general aim of OT is to promote and enable meaningful contextual occupational performance[16]. The vital role of Occupational therapy practitioners in Parkinson's disease is widely recognized from the time of diagnosis[17,18].

Model of health delivery through telecommunication is called as Tele health[19]. Tele rehabilitation is application of rehab services through communication technology[20]. The American Occupational Therapy Association (AOTA) acknowledges the use of Telerehabilitation technologies as a recognized and acceptable method of service delivery for many practitioners within the field of health care, particularly for individuals in remote areas where demands for services may exceed the services available[21]. Telerehabilitation is gaining popularity due to cost effectiveness and reduced transportation issues[22] and widely recognized as a bridge connecting medical professional and the client[23].

Tele rehabilitation is an upcoming, technology based, cost effective rehabilitation. It was found that speech and language was effectively improved through Tele rehabilitation in PD[24] but motor domains especially hand functions which are the foundations of daily activities was not emphasised. Although the use of Tele rehabilitation is limited yet it is proven to be an effective method and can be used as an alternative mode for service delivery[25].

The Study:

Aim: To find the effectiveness of Tele rehabilitation on manual dexterity and its impact on quality of life in clients with Parkinson's Disease-Pilot study.

Participants: The participants were selected from SRM hospital and Research centre, Chennai. After scrutinization of the relevant papers and consent letter approval the research was approved by the research team of College of Occupational Therapy, SRMIST. Quantitative quasi experimental design intervention study was conducted to compare the means between independent groups of variables through a convenience sampling method. In this pilot study ten participants have volunteered to participate. Experimental group(n=5) and control group (n=5). The eligible participants were Patients with Parkinson's Disease, confirmed diagnosis time >6months within age group 40 to 80years, both male and female, Patients with stable drug usage, Hoehn and Yahr stages 1 to 4 and UPDRS(Unified Parkinson's Disease Rating Scale)>30. The Patients with other significant neurological disorders or psychiatric co-morbidity including dementia, MoCA (Montreal Cognitive Assessment) score <21 and Patients participating in another intervention trail were excluded.

Intervention: Participants who had consented were screened using Unified Parkinson's Disease Rating Scale (UPDRS) and Montreal Cognitive Assessment Tool (MoCA). The eligible participants were alloted to either experimental group (Tele rehabilitation) or Control group (Theraband exercises).Both the groups were administered with outcome measures Purdue pegboard test for manual dexterity, CAHAI-13 to measure bilateral upper limb performance in Activities of daily Living skills and PDQ39 to assess the health related quality of life at baseline and after 4 weeks of intervention. Experimental and control group received intervention for 15 sessions for 30 minutes each[13].

Experimental group (Tele Rehabilitation): Prior to the intervention through video call, Researcher gave a booklet[13] explaining all the exercises with pictures and a brief explanation.

Six different exercises were taught through video call:

1. Finger tapping
2. Crossing circles
3. Turning disks
4. Nuts on bolt
5. Modelling clay 1
6. Modelling clay 2

Control Group: Patients were taught to perform 7 upper extremity strength training exercises using the theraband[13].

The Exercises Includes:

1. Elbow flexion
2. Elbow extension
3. Hand abduction
4. Hand Pronation
5. Hand supination
6. Hand extension
7. Hand flexion

Instrumentation:

Screening:

Unified Parkinson's Disease Rating Scale - UPDRS

Montreal Cognitive Assessment Tool - MoCA

Outcome Measures:

Purdue peg board test – Manual dexterity

Chedoke Arm and Hand Activity Inventory (CAHAI-13)-ADL related dexterity performance

Parkinson's Disease Questionaire-39(PDQ-39)-Health related quality of life

The Unified Parkinson's Disease Rating Scale (UPDRS): The UPD rating scale is the most commonly used scale in the clinical study of Parkinson's disease. The UPDRS consists of 6 sections which are evaluated by interview and clinical observation. Both Clinicians and researchers use the UPDRS and the motor section in particular to follow the progression of a person's Parkinson's disease. Its Reliabilty is 0.92 and Validity is 0.76-0.96 [26,27].

Montreal Cognitive Assessment (MoCA): The MoCA test is a 30-point test administered in approximately 10 minutes. The test and administration instructions are available for clinicians online. In a very precise manner MoCA detects Mild Cognitive Impairment. According to the validation study, the sensitivity and specificity of the MoCA for detecting MCI were 90% and 87%[28].

Purdue peg board test: Perdue pegboard test measures manual dexterity and includes four subtests namely dominant hand, nondominant hand, bimanual and assembly task. The score is the number of pegs and pieces placed on the board. The Purdue pegboard test reliably evaluates manual dexterity in patients with Parkinson's disease. Reliability 0.37 to 0.68 and validity value 0.5 - 0.70[29].

Chedoke Arm and Hand Activity Inventory (CAHAI-13): The CAHAI-13 is a performance based test containing 8 real life upper limb functional test rated on a 7-points quantitative scale,with higher score indicating better performance. It has high inter-rater reliability of 0.96-0.99,convergent and discriminant cross sectional validity [13].

Parkinson's Disease Questionaire-39(PDQ-39): Health related quality of life was assessed by PDQ39. It is the 39 items self report questionnaire which assess Parkinson's disease specific health related quality over the last month. It assess how often patient experience difficulties across the 8 quality of life dimension-Mobility, ADL, Emotional well being, stigma, social support, cognition, communication and bodily discomfort. Reliability-0.68-0.95, Validity-0.66[30]

Ethical Consideration: This research was approved by the Research team of SRMIST College of Occupational Therapy, Chennai following thorough scrutinization of the relevant papers and consent letter approval from all the participants.

Results

Total of 10 participants participated in the pilot study. 40% are males and 20% are males. The results revealed that the experimental group has shown significant difference at 5% level in all the metrics

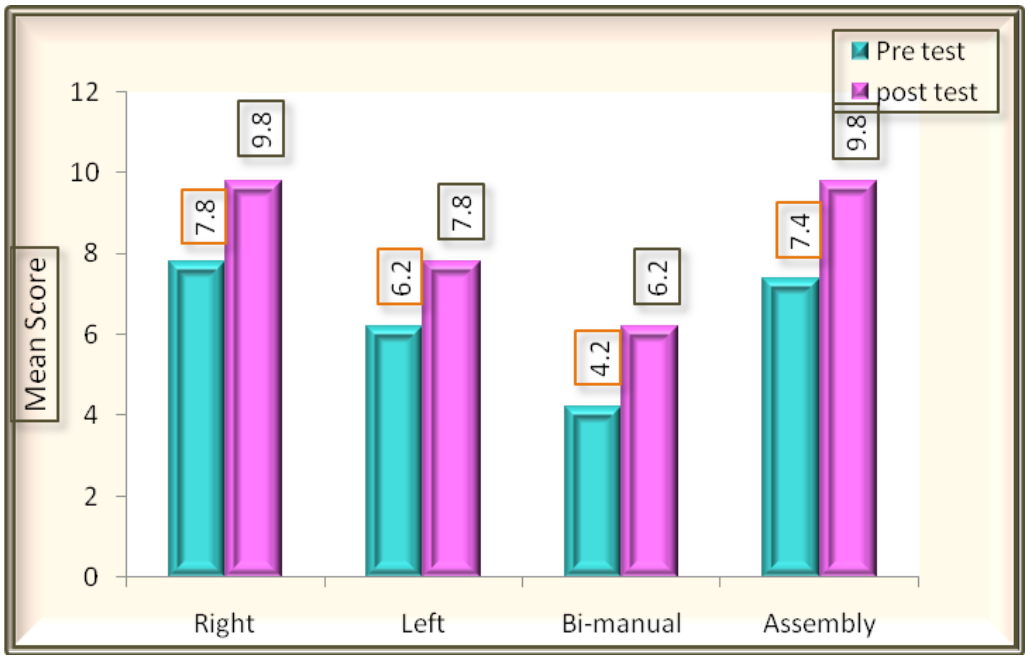
"Right, Left, Bi-manual, Assembly tasks of Purdue Peg Board test, CAHAI 13 and PDQ39. But comparing between the experimental and control groups significant difference at 5% level was observed only in bi manual task of Purdue Peg board test.

Table 1: Difference between pre and post test mean scores of various metrics in experimental Group

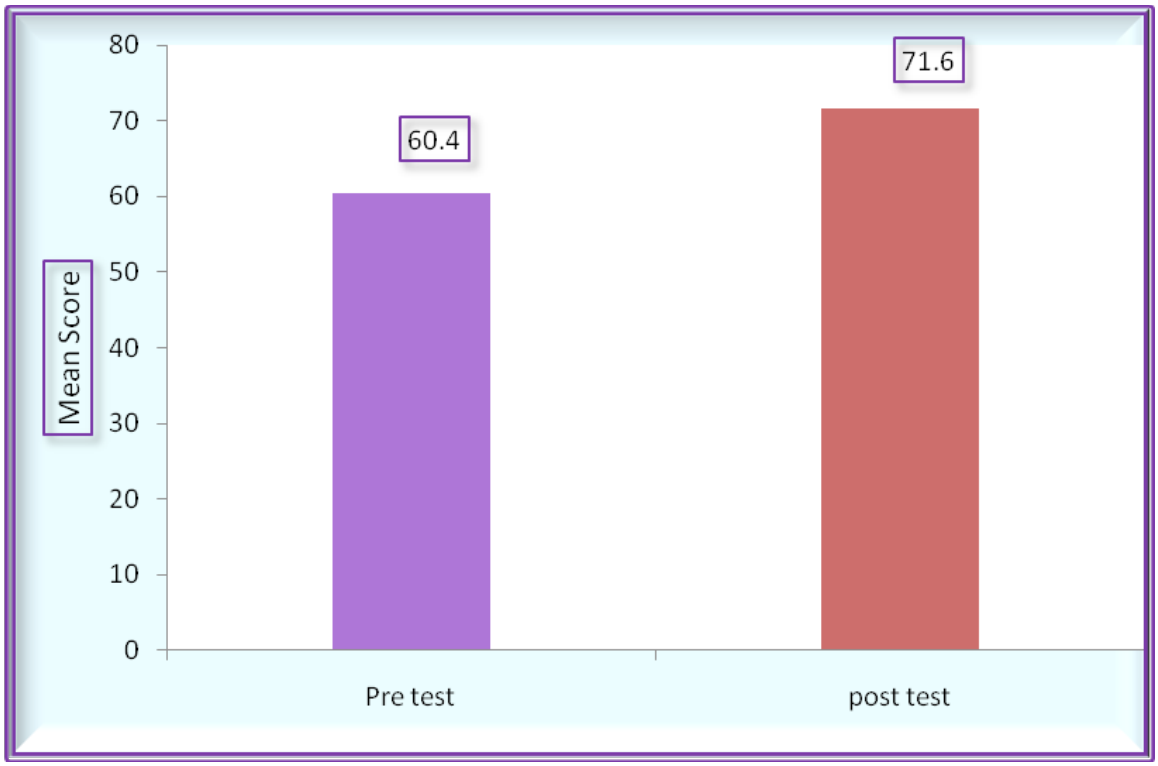
Metrics	Test	N	Mean	SD	t - value	DF	P-value
Right	Pre test	5	7.80	1.483	-6.325	4	0.003**
	Post test	5	9.80	1.789			
Left	Pre test	5	6.20	1.924	-3.138	4	0.035*
	Post test	5	7.80	2.387			
Bi-manual	Pre test	5	4.20	1.483	-3.162	4	0.034*
	Post test	5	6.20	1.483			
Assembly	Pre test	5	7.40	2.302	-6.000	4	0.004**
	Post test	5	9.80	1.924			
PDQ39	Pre test	5	60.40	14.117	-5.091	4	0.007**
	Post test	5	71.60	17.785			
CAHAI 13	Pre test	5	61.80	17.283	-4.727	4	0.009**
	Post test	5	79.40	9.685			

*-Significant at 5% level **-Significant at 1% level

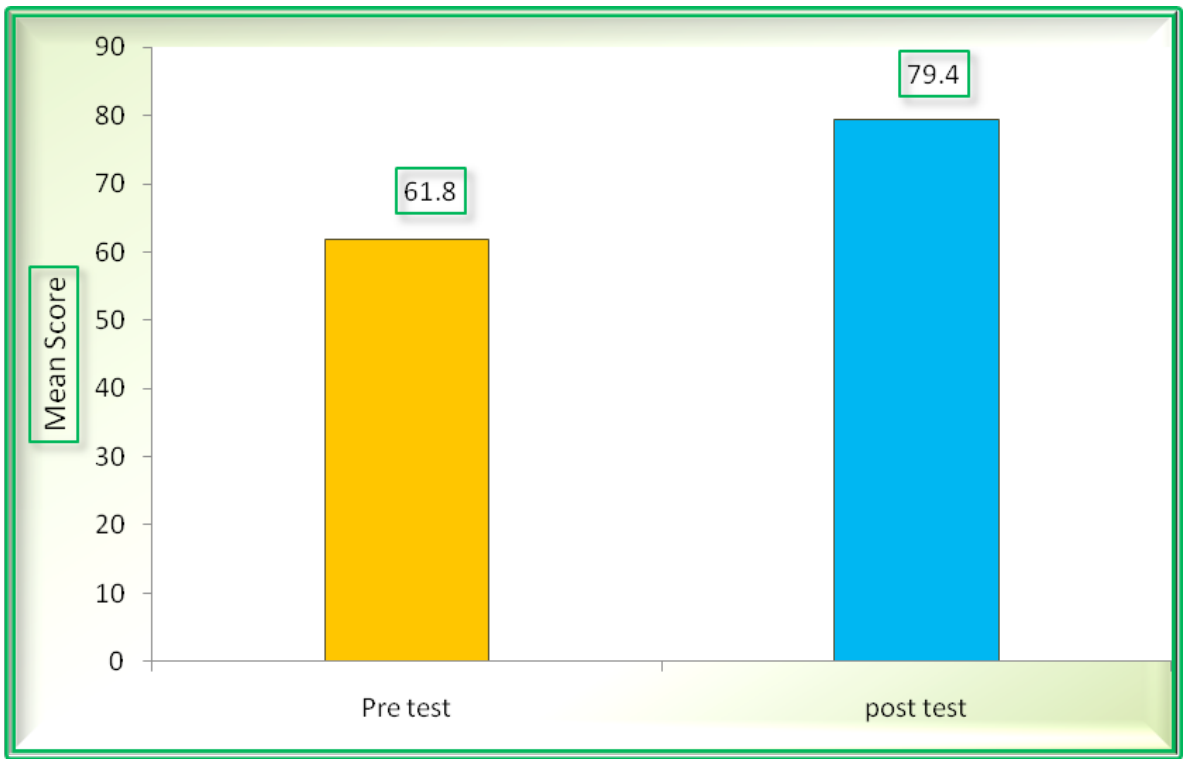
Using paired t test analysis the P-values corresponding to the metrics "Left and Bi-manual" are significant at 5% level showing significant difference whereas the metrics "Right, Assembly, PDQ39 and CAHAI 13" are significant at 1% level showing high significant difference between the mean scores of metrics "Right, Assembly, PDQ39 and CAHAI 13".



Graph 1: Pre test and post test scores of Purdue Peg board test (PPBT) in experimental group



Graph 2 Pre test and post test scores of PDQ 3 in Experimental Group



Graph 3 Pre test and post test scores of CAHAI 13 in Experimental Group

Table 2: Comparison of various metrics between control and experimental group in post test level

S.No.	Metrics	Test	N	Mean	SD	t - value	DF	P-value
1.	Right	Control	5	7.80	1.483	-1.925	8	0.090
		Experimental	5	9.80	1.789			
2.	Left	Control	5	6.80	2.280	-0.677	8	0.517
		Experimental	5	7.80	2.387			
3.	Bi-manual	Control	5	4.20	1.095	-2.425	8	0.042*
		Experimental	5	6.20	1.483			
4.	Assembly	Control	5	6.60	2.608	-2.208	8	0.058
		Experimental	5	9.80	1.924			
5.	PDQ39	Control	5	52.60	12.720	-1.943	8	0.088
		Experimental	5	71.60	17.785			
6.	CAHAI 13	Control	5	59.60	18.703	-2.102	8	0.069
		Experimental	5	79.40	9.685			

*-Significant at 5% level **-Significant at 1% level

Using independent t test the p-value corresponding only to "Bi-manual" is significant at 5% level where as among other metrics no significant difference was observed.

Discussion

In this pilot study, researcher investigated the effectiveness of dexterity training program through online Tele-rehabilitation to improve manual dexterity and eventually dexterity related ADL(Activities of Daily Living) in patients with Parkinson's Disease. Two groups for 4-week manual dexterity training programs focussed on different aspects on manual dexterity and arm and hand function. The dexterity training program predominantly consisted of finemotor dexterity exercises with in-hand manipulation of objects, whereas the Theraband training program predominantly consisted of hand and arm strength training exercises training through online Skype mode.

Table 1 Shows the difference in various metrics in experimental group. The P-values corresponding to the metrics "Right, Assembly, PDQ39 and CAHAI 13" are significant at 1% level and "Left and Bi-manual" are significant at 5% level hence concluded that Tele Rehabilitation was effective. Manual dexterity has been described as being affected in persons with PD[13,31]. Persons diagnosed with PD have reported difficulty with fine manipulative activities and everyday hand activities, along with an impaired ability to perform bimanual tasks simultaneously. Additionally,the intervention showed significant changes in speed and finger movements regarding the Purdue Pegboard Test. Furthermore, the CAHAI-8 as real-life upper limb functional tests and the dexterity questionnaire improved significantly, indicating a positive effect on dexterity-related ADL. The trained exercises improved significantly as well, which can be explained by training effects. This study was successful with the recent development of technology, but tele rehabilitation would be more successful in patients with higher status,with proper care taker or with further implications[13,14].

Table2 shows the mean score difference between control and experimental groups. Only in one metric i.e. bimanual task significant difference was observed but not in other metrics. The participants had difficulty in following instructions inspite of hand outs. Most of them required verbal and physical cues from the care givers as they were not well worsed in using technology. Some had net work disturbances. All this considerations could have influenced the scores.

Finally the dexterity training program after 4 weeks of intervention through Tele Rehabilitation has shown significant changes in manual dexterity.

Conclusion

Manual dexterity is an important component in day today life activities. Inadequate manual dexterity hinders the level of independence. Parkinson's disease clients have compromised manual dexterity thereby dexterity

related ADL skills. HOMEDEXT program was effective in Parkinson's disease through Tele Rehabilitation.. In developing countries like India with vast population, neuro rehabilitation poses a great challenge with minimal resources, Tele rehabilitation could combat this issue.

Limitations: The main limitation of the present study is lack of technology facilities like poor network connection, need of care giver assistance and short study duration.

Implications: As this study has higher scope in neurological conditions various settings could be explored. People who can't reach clinical setup easily will find Tele rehabilitation more affordable.

Recommendations: Use of laptop instead of mobile phones is more convenient.

Selecting patients with proper care givers assistance will be more beneficial.

Further study can be done on a larger scale, on a random sample and in different parts of the country

Follow up studies should be included.

Source of Funding: Self

Conflict of Interest: Nil

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