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COMPARISON OF COGNITIVE MOTOR STRATEGY AND RESISTANCE TRAINING ON FUNCTION AND FALL RISK IN PARKINSON'S

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ABSTRACT

Background: Idiopathic Parkinson's disease (IPD) is a neurological condition that worsens with time and is characterised by both motor and non-motor symptoms that lead to problems with balance, mobility, and fall risk. Medication and physical therapy techniques must be used in tandem for effective management. Focussing certain functional impairments, Cognitive Motor Strategy Training (CMST) and Progressive Resistance Training (PRT) may enhance results.

Aim: To evaluate how CMST and PRT affect people with IPD's mobility, balance, functional results, and risk of falling.

Methodology: This experimental pre-test and post-test investigation was carried out at KG Hospital in Coimbatore over a period of eight months. Thirty patients between the ages of 50 and 70 who had MMSE scores more than 24 and stage II or III IPD (Modified Hoehn and Yahr Scale) were split into two groups at random. While Group B received PRT together with traditional treatment, Group A received CMST along with traditional physiotherapy. For six weeks, each group received 60-minute sessions four times a week. The Tinetti Performance Orientated Mobility Assessment (POMA), the Berg Balance Scale (BBS), and the Fall Efficacy Scale (FES) were used to measure the results both before and after the intervention.

Results: Group A showed greater gains (BBS: +8.8, POMA: +3.3, FES: +7.67) compared to Group B (BBS: +4.4, POMA: +2.25, FES: +6.53). Between-group comparisons favoured CMST ($p < 0.05$). Those two groups showed significant improvements ($p < 0.05$).

Conclusion: For improving mobility, balance, and lowering the risk of falls in people with IPD, CMST works better than PRT. CMST may improve functional results when incorporated into rehabilitation regimens.

Keywords: Idiopathic Parkinson disease, Cognitive motor strategy training, Progressive resistance training, Berg balance scale, Tinetti performance-oriented mobility test, Short– Fall efficacy scale

INTRODUCTION

Parkinson disease is a neurodegenerative disorder and progressive condition. It is the second most degenerative disorder after the Alzheimer disease characterised by degeneration of the dopaminergic cells in the Substantia Nigra of basal ganglia which leads to functional impairment and high risk of fall which can further leads to secondary complications for the patients. Primary features Parkinson disease termed as "cardinal signs" which are rigidity, tremor, bradykinesia, and postural instability. (Terry Ellis et al., 2017). Prevalence among males than females, common age group above 50 years and affect about 6 million people worldwide. The

incident rate is estimated to be 9.7 to 13.8 cases per 1, 00,000 every year. (1)

Parkinson's disease was first described in 1817 as Shaking Palsy by James Parkinson Idiopathic (unknown) or genetically determined is the aetiology. There are now two separate clinical subgroups. One group consists of people whose primary symptoms were gait disruption and postural instability (postural instability gait disturbed [PIGD]). Another category consists of those who are mostly tremorous and usually show minimal bradykinesia or poor posture. Parkinson's disease is a broad term used to refer to a collection of disorders characterised by a main disruption in the basal ganglia's (BG) dopamine circuits. There are known effects from both hereditary and environmental factors. The most prevalent kind of Parkinson's disease, known as idiopathic Parkinsonism, affects around 78% of sufferers.(2).

Parkinson's disease symptoms are classified as either motor or non-motor, and they will vary from patient to patient. Tremor, bradykinesia, rigidity, postural abnormalities, lack of facial expression, dysarthria, and irregular gait are examples of motor symptoms. Non motor symptoms such as depression, urinary frequency\urgency, sleep disturbance, skin problems, Dysphagia, cognitive dysfunction, Autonomic Dysfunction, Anxiety.(3)

Parkinson patients were commonly reporting balance disturbances which can leads to fall and mobility compromises. People with Parkinson's disease who have fallen 38% of the time, 13% more than once a week, and some who have fallen many times during the day; Individuals with Parkinson's disease are five times more likely to fall and get injuries from falls than healthy older individuals.(4)

The falls in Parkinson disease is primarily due to muscle weakness and postural instability. Many of the studies says that during movement initiation dyssynchrony of reciprocal innervated leg muscles and impaired the muscle strength of ankle and the knee are cumulatively impair the normal maintenance of balance and postural stability. Mainly the person with Parkinson disease shows that minimal peak torque production in the knee flexion, knee extension and ankle Doris's flexion than the healthy adults.(5)

Freezing is a crippling symptom of Parkinson's disease that can lead to falls, lower independence, and a lower quality of life. The abrupt inability to start or continue walking, particularly while turning, in stressful situations with little time, or when entering via narrow spaces like doors, is known as freezing of gait. (6)

Mobility is a person's ability to move around safely in different situations and environments to achieve their functional tasks with good control of gait and balance. Mobility is the term of bradykinetic gait features such as slow turns, reduced trunk rotation, and reduced arm swing. In the Parkinson patients even the simple mobility tasks such as stand to sit and sit to stand are affected. The altered attention may affect the mobility and balance control.(7)

One of the characteristics of Parkinson's disease is postural instability, which makes it challenging for each person to carry out basic tasks like walking and moving. Parkinson disease demonstrates abnormalities of posture and balance, resulting in postural instability. These changes are rare in the early years (i.e., the first 5 years after diagnosis). Patients demonstrate abnormal and inflexible postural response controlling their centre of mass (COM) within their base of support (BOS).(8) Patients also experienced increased difficulty during dynamic destabilizing activities such as self-initiated movements (e.g.: functional, reach, walking, turning) and perform poorly under conditions of perturbed balance.(9)

Falls are common with high incidence rate of 40% to 70% in peoples with Parkinson disease. The frequent falls in patient with Parkinson disease can lead people to physical injury, negative psychological effects which may limit their mobility and ability to perform their daily activities, so the Parkinson patients should focus equally on fall prevention program along with their regular intake of medicine and physical therapy.(10)

Parkinson's disease treatment becomes increasingly difficult over time for people with advanced and moderate illness (stage III or above on the Hohen-Yahr classification of disability scale). Levodopa/carbidopa is the gold standard drug in pharmacological treatment. One kind of medication that directly blocks the brain's dopamine receptors is called a dopamine agonist. In nutritional management is the high protein diet as high calorie, low protein diet. Deep brain stimulation is a type of implantation of electrodes in the brain they were stops the nerve signals that causes the symptoms.

Gamma-knife radiosurgery is a type of radiation therapy used to treat tumours, vascular malformations and other abnormalities in the brain.(11)

The combined treatment of physical therapy and pharmacological treatment have a vital role in the Parkinson disease peoples. Early treatment plays an important role to prevent the musculoskeletal problems. The enhancement of motor function, functional performance, activity participation, and exercise capacity will be the main goals of the treatment. The results will be better if patients, carers, and family members are supported and educated at every level. Motor learning strategies, exercise training, relaxation techniques, resistance training, functional training, balance training, locomotor training, spinal orthotics, pulmonary rehabilitation, speech therapy, aerobic exercise, and group and at-home exercises are among the physical therapy treatments provided to Parkinson's patients. (12)

The Victorian comprehensive Parkinson disease program (Australia) served as the foundation for cognitive motor strategy training. Cognitive motor strategy training aims to teach people with Parkinson's disease how to use their attention and frontal cortical region to compensate for movement disorders. They learn how to increase their mobility through visualisation, mental rehearsal, focused attention, part-practice, visual cues, or auditory cues. The exercises of musculoskeletal are mainly aim to improve strength, joint range of motion, muscle length aerobic capacity and endurance.(13)

Progressive resistance training is another important therapeutic intervention for Parkinson disease patients. It mainly focuses on the symptoms like bradykinesia and muscle weakness of Parkinson disease. Several researchers found that there was an improvement on has in the muscular strength, muscular endurance and neuromuscular function in progressive resistance training and thereby improvement in their quality of life for the Parkinson survivors.(14)

Need for the study:

Parkinson disease sufferers experience increasing impairment even after receiving sophisticated medical treatments and undergoing extensive surgery. Numerous supplementary therapies, including as yoga, occupational therapy, and physical therapy, should help to optimise the patient's functional result and independence in his everyday activities. Using movement rehabilitation in conjunction with patient education and support, physiotherapy plays a critical role in maximising functional capacity and minimising secondary problems. Physiotherapy exercises help to alleviate the consequences of Parkinson's and minimize deterioration in strength, endurance, flexibility and balance. Towards the later sessions, the physiotherapist will focus on improving gait, balance, manual activities and reduce fall risk. Management through physiotherapeutic intervention lies from a traditional based program such as, stretching, strengthening and relaxation exercises, postural control, balance retraining and gait training program or the recent advanced treatment such as PNF, Cognitive motor strategy training, cueing training (visual & auditory),Action Observation Training, Amplitude training (LSVT-BIG), also some ancient therapies like Yoga and Tai chi may produces some beneficial effect over the patient signs and symptoms.(15)

Among the various recent advanced treatment programmes, Cognitive motor strategy training promotes more beneficial effect in improving functional independence teaches people to work their frontal cortex to move more easily, safely and quickly using conscious control. Among the traditional based program progressive resisted exercises is goal to increase muscular strength, muscle power, joint range of motion and helpful in reducing motor deficits. There is sufficient literature support for the efficacy of Cognitive motor strategy training as well as progressive resisted exercises in improving the functional outcome of patients with idiopathic Parkinson disease. This is the first of this kind of study, to find out which technique is more beneficial and to compare the effect between the cognitive motor strategy training and progressive resisted exercises in improving the functional outcome and prevention of fall risk among Parkinson patients. (16)

METHODOLOGY

This pre-test and post-test experimental study was conducted over eight months at the Departments of Neurology and Physiotherapy, KG Hospital, Coimbatore, to find out the impact of cognitive motor strategy training and progressive resistance training on fall risk and functional outcomes in patients with idiopathic Parkinson’s disease. Thirty

patients meeting the inclusion criteria—aged 50 to 70 years, clinically diagnosed with idiopathic Parkinson's disease, classified as stage II or III on the Modified Hoehn and Yahr Scale, and Mini-Mental State Examination score greater than 24, ambulatory, and not acutely ill—were recruited and randomly assigned into two equal groups of fifteen participants each. Patients with other neurological disorders, neuroleptic or major tranquilizer usage, significant cardiorespiratory issues, gross autonomic dysfunction, musculoskeletal problems, or receiving adjunct therapies were excluded. Demographic data, including age, gender, hand dominance, occupation, and symptom duration, were collected, and baseline assessments were performed using the Fall Efficacy Scale, Berg Balance Scale and Tinetti Performance Oriented Mobility Assessment. Group A received cognitive motor strategy training combined with conventional physiotherapy, while Group B underwent progressive resistance training along with conventional therapy, with both groups receiving 60-minute sessions, four times a week for six weeks. Everyone were provided written consent, instructed to report any discomfort during the treatment duration and informed about the study. Post-intervention, assessments were repeated using the same outcome measures, and the results were statistically analysed to compare the effectiveness of the two interventions on mobility, balance, and fall risk.

STATISTICAL ANALYSIS

Using Student's t-test the collected data were analysed to evaluate the effectiveness of the interventions. The paired t-test was used to compare the post-test values and pre-test within each of the group for the Berg Balance Scale, Fall Efficacy Scale and Tinetti Performance Oriented Mobility Assessment. Paired t-test formula used was:

$$S=\sqrt{\frac{\sum d^2-\frac{\sum_d 2}{n}}{n-1}} \qquad t=\frac{\bar{d}\sqrt{n}}{s}$$

The d represents the difference between pre-test and post-test scores, d¯\bar{d}d¯ is the mean difference, n is the number of subjects in each group, and S is the standard deviation of the differences.

An unpaired t-test was applied to differentiate post-test scores between Group B (Progressive Resistance Training) and Group A (Cognitive Motor Strategy Training) to evaluate between-group differences in functional outcomes. The unpaired t-test formula used was:

$$S=\sqrt{\frac{\sum(x_1-\bar{x}_2)^2+(x_2-\bar{x}_2)^2}{n_1+n_2-2}} \qquad T=\frac{\bar{\bar{x}}_1-\bar{\bar{x}}_2}{S}\sqrt{\frac{n_1n_2}{n_1+n_2}}$$

where n1n_1n1 and n2n_2n2 are the sample sizes of Group A and Group B respectively, x1x_1x1 and x2x_2x2 are the individual post-test scores of each group, x¯1\bar{x}_1x¯1 and x¯2\bar{x}_2x¯2 are the mean scores of each group, and S represents the pooled standard deviation.

A p-value of less than 0.05 was regarded as statistically significant, and all statistical tests were two-tailed. Standard statistical software was used for the analysis.

RESULT

The present study evaluated and compared the effects of Cognitive Motor Strategy Training and Progressive Resistance Training on balance, mobility, and fall risk in patients with idiopathic Parkinson's disease using the Fall Efficacy Scale (FES), Tinetti Performance Oriented Mobility Assessment (POMA) , and Berg Balance Scale (BBS).

Berg Balance Scale (BBS)

In Group A, mean pre-test score was 33.53, which improved to 42.33 post-treatment, with a mean difference of 8.8 ± 4.95. The paired t-test yielded value of the 16.9, which was statistically significant of the value ($p < 0.05$) as mentioned the Table 1.

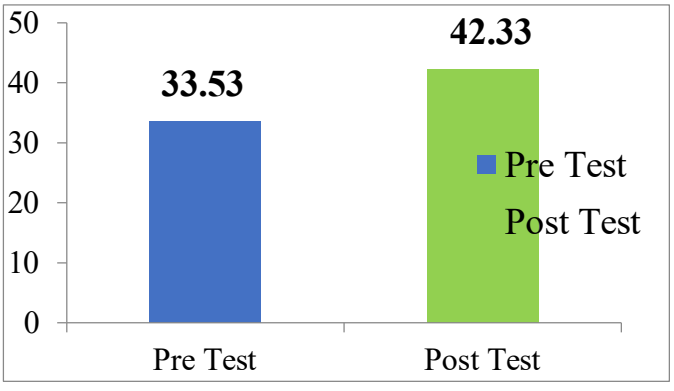


Figure 1: Compared of pre and post-test values of group A

In Group of B, the pre-test mean that 33.73 and the post-test mean was 38.13, with a mean difference of 4.40 ± 5.68.

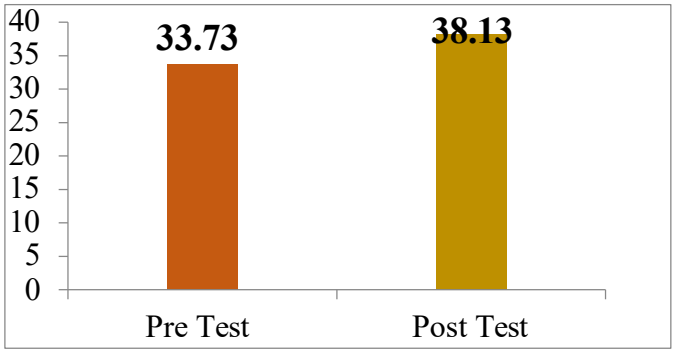
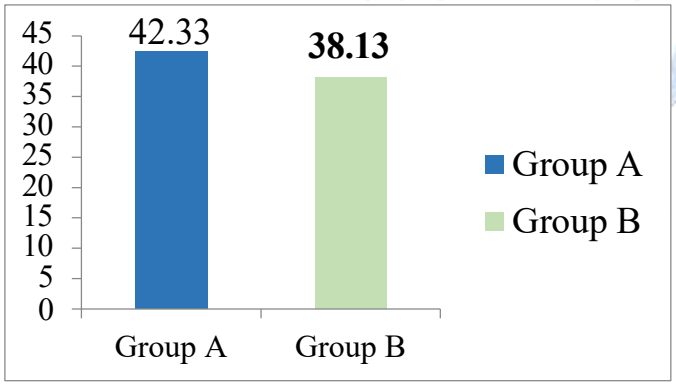


Figure 2: compared of pre and post test values of group b

The paired t-test values was 6.89, also statistically significant ($p < 0.05$). On comparison of the post-test scores between Group B and Group A using unpaired t-test, In Group A (42.35 ± 4.95) showed a significantly higher improvement than Group B (38.13 ± 4.95), with a mean difference of 4.46 and a t-value of 2.47 ($p < 0.05$).

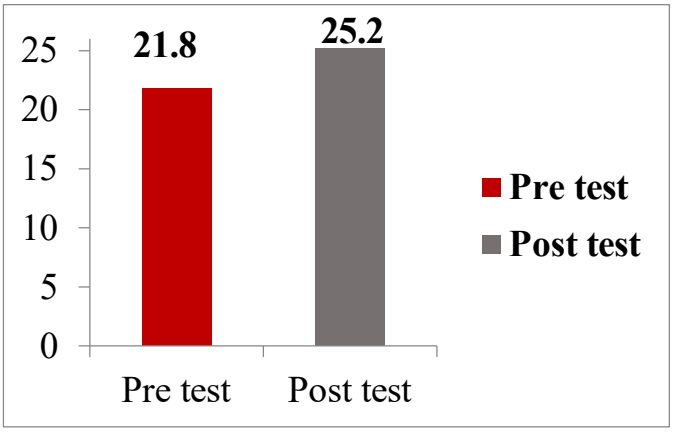
Figure 3: compared of post-test values of Group B and Group A



Tinetti Performance Oriented Mobility Assessment (POMA)

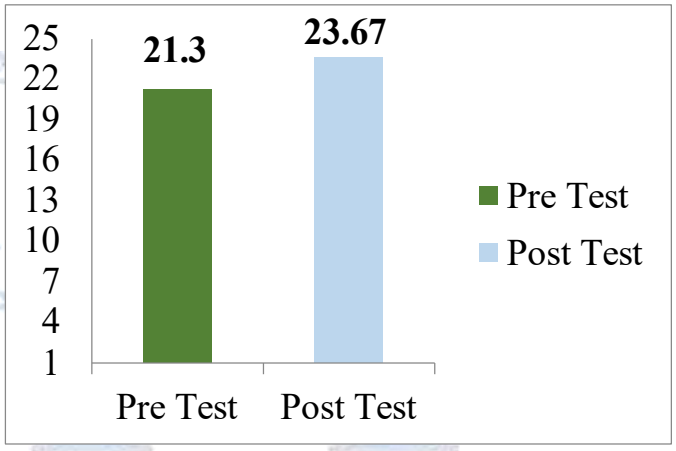
In Group A, the mean pre-test score was 21.8 and improved to 25.2 post-treatment, with a mean difference of 3.3 ± 1.37. The paired t-test yielded a value of 8.62 ($p < 0.05$), indicating significant improvement.

Figure 4 : compared of pre test values of group A and group B



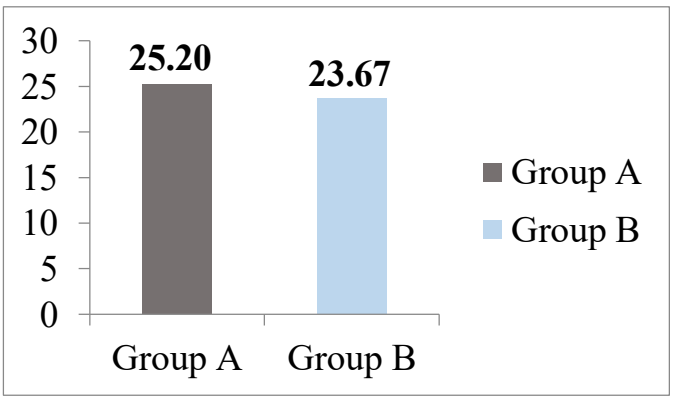
In Group B, the pre-test mean was 21.13 and post-test mean was 23.67, with a mean difference of 2.25 ± 1.81, the paired t-test value = 8.26 ($p < 0.05$).

Figure 5 : COMPARISON OF PRE TEST AND POST TEST VALUES OF GROUP B



The post-test comparison between Group A (25.20 ± 1.37) and Group B (23.67 ± 1.37) showed a mean difference of 1.53, with an unpaired t-test value of 2.58, it was statistically it was significant ($p < 0.05$).

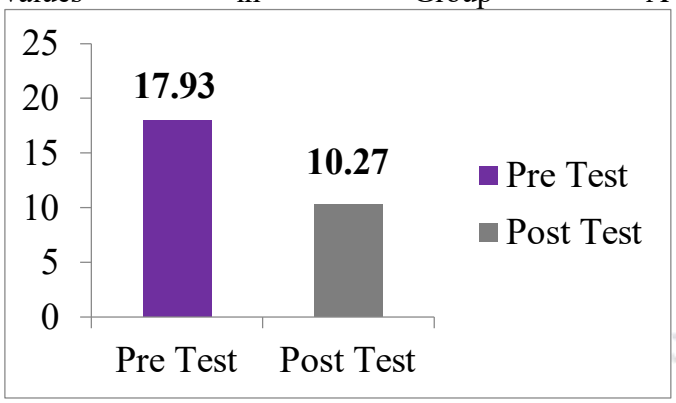
Figure 6 : comparison of post test values if group a and group b



Fall Efficacy Scale (FES)

In Group A, the mean pre-test score was 17.93, which reduced to 10.27 post-treatment, showing a mean difference of 7.67 ± 1.79. The paired t-test value was 16.50, which was statistically significant ($p < 0.05$).

Figure 7: compared of pre test values and post test values in Group A



In Group B, the pre-test mean was 18.60 and the post-test mean was 12.07, yielding a mean difference of 6.53 ± 1.62. The paired t-test value was 10.29 ($p < 0.05$).

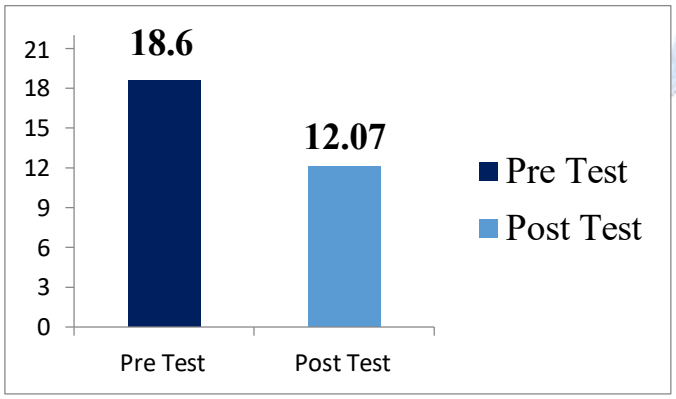


Figure 8: comparison of pre test and post test values in group b

The post-test comparison between Group A (10.60 ± 1.62) and Group B (12.07 ± 1.62) showed a mean difference of 1.47, and the unpaired t-test value was 2.20, which was statistically significant ($p < 0.05$).

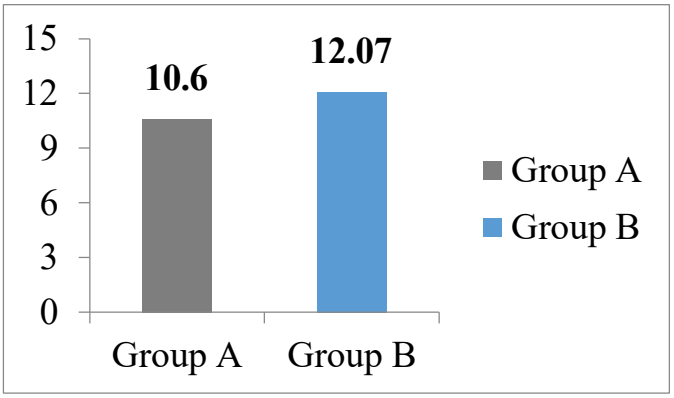


Figure 9: comparison of post test values in group a and group b

Overall Interpretation

Both intervention groups demonstrated statistically significant improvements in balance, mobility, and fall efficacy following treatment. However, Group A, which received Cognitive Motor Strategy Training along with conventional therapy, showed superior improvement compared to Group B, which received Progressive Resistance Training with conventional therapy across all outcome measures.

DISCUSSION

Both motor and neurological symptoms are present in Parkinson's disease, a chronic progressive neurological condition. The disorder often causes stiffness or slowing of movement, postural changes, and gait disturbances, which can significantly impair the patient's ability to independently handle self-care tasks and activities of daily living. Symptoms can begin gradually, sometimes with a barely perceptible tremor in just one hand. (17) Since medication can possibly reduce the signs and symptoms of the patient temporarily, depending upon a pharmacological management strategy alone will not reduce the severity of the condition thereby advanced physiotherapeutic approaches optimally modify the symptoms and reducing the severity.(18)

In the context of education and support for the full person, the goal of physiotherapy for Parkinson's disease is to improve functional capacity and reduce secondary problems through movement rehabilitation. (19)

The goal of the current study was to evaluate cognitive motor strategy training with progressive resistance training in Parkinson's patients who were receiving standard therapy. There were 15 patients in each of the two groups that were randomly

assigned. One group received conventional therapy and cognitive motor strategy training, whereas the other group received conventional therapy and progressive resistance training. For six weeks, four sessions per week were provided to each group. (20).

The parameters in outcome were analysed by using balance, mobility and fall risk. Balance was assessed with Berg Balance Scale, Mobility was assessed with Tinetti Mobility test and fall risk was assessed with Fall Efficacy scale.(21,22)

After tabulating the results, statistical data analysis was done. Comparing the pre-treatment values of Groups A and B revealed no significant differences in the Berg Balance Scale or the fall efficacy scale. A comparison of pre- and post-test findings between groups, both within Groups A and B, revealed significant improvements on the Berg Balance Scale, Tinetti Poma Scale, and fall efficacy scale after the intervention. This is shown by the incredibly large "t" values for both Group A and Group B. (23)

However, the comparison of post-test values between Group A and Group B showed that there was more significant improvement in Group A than Group B for Berg Balance Scale, tinetti poma test and fall efficacy scale scores that is (t = 2.47) for tinetti mobility test and (t=2.58) for fall efficacy scale (t=2.20). all three measures were significantly improved in the Cognitive Motor Strategy Training group than the Progressive Resistance Training Group.

Studies which was done by the Morris and Iansek, the movement strategy training teaches to use attentional strategies to consciously bypass the motor information to basal ganglia, without reaching frontal cortex to execute the motor tasks. Structured practise like cognitive motor strategy training enhances motor performance by breaking down complex movement sequences into segments and delivering attention to each segment which make the performances of whole activity easier.(24)

Mentally practicing upcoming motions, paying attention to the movement, and using a range of additional visual or aural cues are all additional elements of movement strategy training. Evidence supports the use of a range of additional visual or aural signals. Cognitive motor strategy training appears to be a good fit for Parkinson patients since there is evidence that the condition decreases the flexibility of motor learning, which increases the demand for task-specific practice. (25)

The intentional stimulation of the motor cortex, which overrides the loss of basal ganglia function, may be one of the mechanisms for the improvement. Overactivity in the unaffected cerebellum and lateral premotor regions may indicate an adaptive mechanism that allows patients to overcome their movement abnormalities by using sensory or attentional guidance, according to recent research. (26)

The second mechanism could be that it helps to repeat the functional motions themselves, particularly when signals are present and the functional tasks are carried out in the best possible way. (27)

In the present study, the data analysis showed that patients obtain significant improvement in Berg Balance Scale, Tinetti Poma test and fall efficacy scale that is improvement in mobility, balance, fall risk. The fall risk, balance and mobility are the 3 important domains need to be addressed in Parkinson patients, which will in turn improve the patients independence in quality of life and functional activity.(28)

CONCLUSION

Patients with Parkinson's disease frequently experience progressive mobility impairments, including difficulties with transfers, posture, balance, gait, and an high risk of falls. Although various physiotherapy interventions are available for managing these symptoms, their relative effectiveness remains debated.Current study compared the efficacy of Progressive Resistance Training and Cognitive Motor Strategy Training on mobility, balance, and fall risk in with idiopathic Parkinson's disease patients.(29) The findings demonstrated that while both interventions produced significant improvements in functional outcomes, the group receiving Cognitive Motor Strategy Training showed superior improvements across all measured parameters. This suggests that Cognitive Motor Strategy Training can be an effective adjunct to conventional physiotherapy, offering greater benefits in enhancing mobility, fall prevention and balance in patients with idiopathic Parkinson's disease. In conclusion, Cognitive Motor Strategy Training appears to be a more effective intervention than Progressive Resistance Training for improving

balance, mobility, and reducing fall risk in patients with idiopathic Parkinson's disease. Incorporating Cognitive Motor Strategy Training into routine rehabilitation protocols may provide substantial clinical benefits for this population.(30)

LIMITATIONS AND RECOMMENDATIONS

The study's short length, small sample size, and lack of follow-up have hampered its generalisability and long-term validity of the findings. There was insufficient control over outside factors such participant variability, contextual factors, and drug effects. To confirm and extend these findings, more research with bigger sample numbers, longer duration, age-group stratification, and long-term follow-up is advised.(13) Further studies should examine how Cognitive Motor Strategy Training affects other significant outcomes including disability rating, quality of life, and its suitability for additional Parkinsonian disorders such multiple system atrophy and progressive supranuclear palsy.(22)

AUTHOR CONTRIBUTIONS

Jith U. S. carried out the intervention procedures, research design and conception, data collecting, statistical analysis, and paper draughting. In addition to overseeing the research process, helping with data interpretation, and critically revising the paper for significant intellectual content, Dr. S. Harihara Sudan offered advice on the study design. The final draft of the text was authorised by both writers, who also agreed to take responsibility for every part of the work.

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