CERTIFICATE

Reg No: U15PT030 Date:

This is to certify that **Ms. S. RAMYA** Student of Sree Balaji College of Physiotherapy has satisfactorily completed this dissertation work on

"THE EFFICACY OF CORE STRENGTHENING EXERCISES IN PARKINSON'S DISEASE WITH DEEP BRAIN STIMULATION"

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ABSTRACT

TITLE: THE EFFICACY OF CORE STRENGTHENING EXERCISES IN PARKINSON'S DISEASE WITH DEEP BRAIN STIMULATION

INTRODUCTION:

Parkinson's disease was first described by Dr. James Parkinson as a "Shaking Palsy" in 1817. It is a chronic, progressive and neurodegenerative movement disorder characterized by motor and non-motor symptoms and reduced quality of life (QOL). The incidence and prevalence of PD increases with advancing age, being present in 1% of people over the age of 65 years. Early-onset Parkinson's Disease (EOPD) is defined as the onset of parkinsonian features before the age of 40 years. It accounts for 3-5% of all PD cases. PD is twice as common in men than in women in most population.

AIMS AND OBJECTIVES:

The study aims at improving the ability of balance in Parkinson's Disease with Deep Brain Stimulation (DBS).

BACKGROUND:

Parkinson's disease (PD) is a progressive neurologic disorder and is the second most common neurodegenerative disease affecting the elderly. Parkinson's disease patient has symptoms like tremor, rigidity, bradykinesia and postural instability. People with PD often show limited participants in physical activity, which in turn, may reduce functional status and contribute to secondary health complications.

MATERIALS AND METHODOLOGY:

Subject of 54-year-old male affected by Parkinson's disease involved in this study and treated 2 times a week for 24 weeks, with core strengthening exercises.

RESULTS:

Subject pre UPDRS score was 32.35 and after Core Training post UPDRS score was 16.17, his balance ability has improved, risk of fall has decreased and significant improvement in activities of daily living after 24 weeks of Core Training.

CONCLUSION:

Core strengthening exercises improve posture control and ability of balance in Parkinson's disease. The case study concludes that the core strengthening exercises were more effective in subject with Parkinson's Disease.

KEYWORDS:

Parkinson's disease (PD), Deep brain stimulation (DBS), Activities of daily living (ADL), Quality of life (QOL), Basal ganglia (BG), Unified Parkinson's Disease Rating Scale (UPDRS), Medical Outcomes Study Questionnaire Short Form 36 Health Survey (SF-36), Core Strengthening (CS).

INTRODUCTION

The Basal Ganglia is a network of subcortical nuclei consisting of the caudate nucleus, the putamen, the globus pallidus, and the subthalamic nucleus along with the substantia nigra. The caudate and putamen together are called the striatum. The BG engages in a number of parallel circuits or loops, only a few of which are motor.

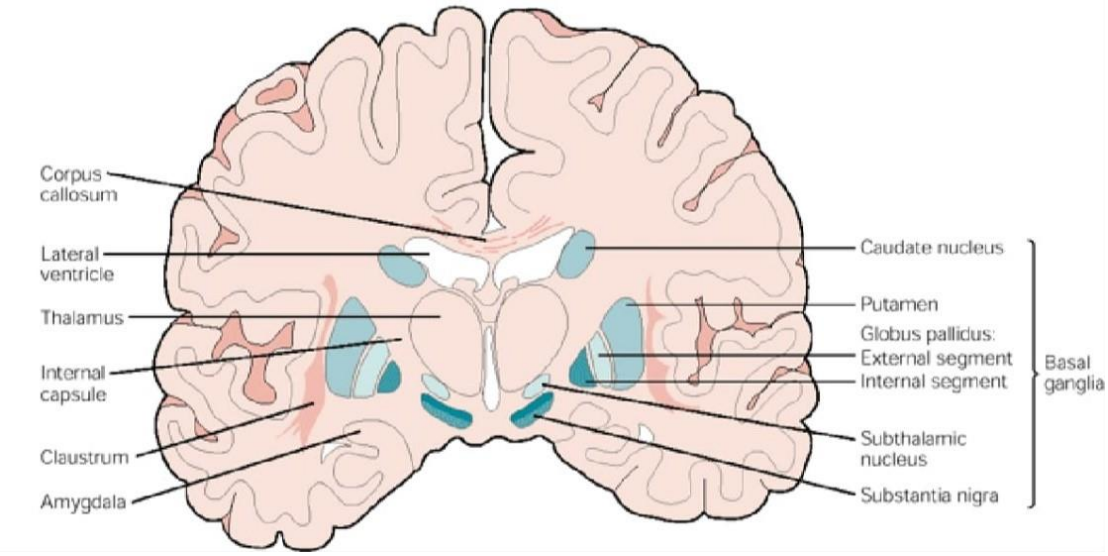


Fig.1: The coronal section of Basal Ganglia. (Nieuwenhuyse *et al*, 1981)

Direct motor loop: Through the BG consists of signals transmitted from the cortex to putamen to globus pallidus, to ventrolateral (VL) nucleus of the thalamus, and back to cortex (supplementary motor area [SMA]). This VL-SMA connection is excitatory and facilitates discharge of cells in the SMA. The BG thus serves to activate the cortex via a positive-feedback loop and assists in the initiation of voluntary movement. Inhibition of the thalamus by the BG is thought to underlie the hypokinesia seen in PD.

Indirect motor loop: Through the BG involves the subthalamic nucleus, the globus pallidus interna, and substantia nigra pars reticulate to the superior colliculus

and midbrain tegmentum. This indirect loop serves to decrease thalamocortical activation. The BG projection to the superior colliculus assists in regulation of saccadic eye movements. The BG projection to the reticular formation assists in the regulation of trunk and limb musculature (via extrapyramidal pathways), sleep and wakefulness, and arousal. Other circuits in the BG are involved with memory and cognitive function (Gilman *et al*, 2008).

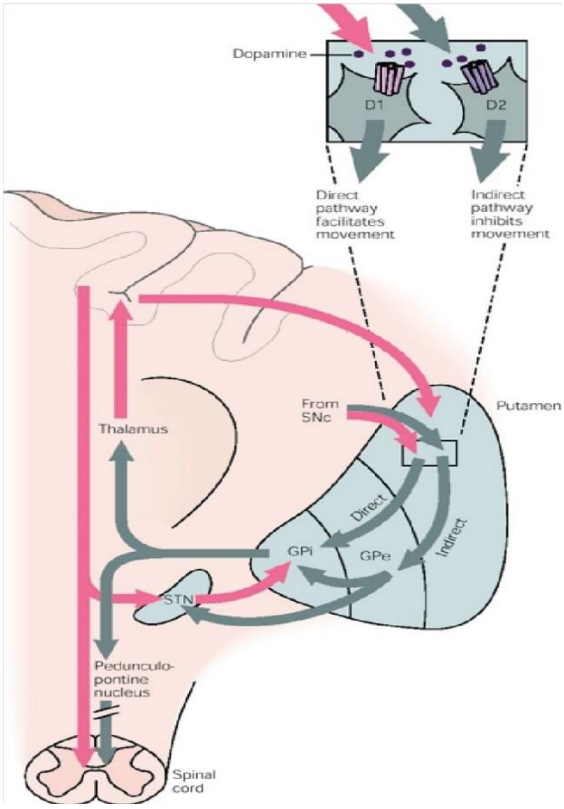


Fig.2: The parallel direct & indirect pathways from the striatum to the Basal Ganglia to the output nuclei. (Mahlon, 1981)

Parkinson's disease (PD) is a progressive condition involving degeneration of dopaminergic cells. PD represents a major neurodegenerative disorder, ranking second in prevalence worldwide (De Lau *et al*, 2006), and is predicted to become even more common in the future, as the population ages (Tan, 2013).

Causes of PD are Genetic and Environmental Factors. Several genetic changes (mutations) have been identified as increasing a person's risk of developing

Parkinson's disease, although exact cause of this condition is unclear. Recent studies have identified mutations in a number of pathogenesis genes (SNCA, Parkin, UCHL1, DJ-1, PINK-1, LRRK2 and ATP13A2 genes) that contribute to familial forms of PD (Riess *et al*, 1998).

Some environmental factors may increase a person's risk of developing PD. It has been suggested that pesticides and herbicides used in farming and traffic or industrial pollution may contribute to the condition. The potential environmental risk factor includes farming activity, pesticide exposures, well-water drinking, and history of head trauma (Lin *et al*, 2011).

Table.1: Motor and Non-Motor Symptoms of Parkinson's Disease (Opara, 2003)

Motor	Non-Motor
Tremor	Sleep disturbance
Rigidity	Depression and anxiety
Bradykinesia (slow movement)	Fatigue
Postural instability(balance problems)	GIT related issues
Walking/gait problems	Urinary issues

It may be classified as primary or idiopathic and secondary parkinsonism. Idiopathic late-onset (>40 years is generally sporadic), early-onset (<40 years is often familial). Young-onset (>21 years), Juvenile (<21 years). Secondary Parkinson-plus syndromes refers to those conditions that mimic PD in some aspects, but the symptoms are caused by other neurodegenerative disorders. Parkinson-plus syndrome include: Progressive supranuclear palsy, Multiple system atrophy, Corticobasal degeneration, Lewy body dementia (Wenning *et al*, 2000).

Table.2: Hoehn-Yahr Classification of Disability (Hoehn *et al*, 1967).

Stage	Character of Disability
I	Minimal or absent; unilateral if present.
II	Minimal bilateral or midline involvement. Balance not impaired.
III	Impaired righting reflexes. Unsteadiness when turning or rising from chair. Some activities are restricted, but patient can live independently and continue some forms of employment.
IV	All symptoms present and severe. Standing and walking possible only with assistance.
V	Confined to bed or wheelchair.

Epidemiological studies on the incidence of PD are important to better understand both the risk factors for PD and determine the condition's natural history. As PD predominantly affects older adults, worldwide aging populations, especially in economically developed countries, will increasingly need to develop strategies to meet the health care needs of individuals with PD. The incidence of PD between age groups and gender can be used to effectively direct these strategies to appropriate populations (Twelves *et al*, 2003)

Worldwide the burden of Parkinson's disease is set to rise in the coming years. It was estimated that in western Europe in 2005 the number of people with Parkinson disease rise from 4.1 to 4.6 million and it is expected to rise two times to 8.7 to 9.3 million in the year of 2030. On the other hand, in Asia the number is expected to increase from 2.57 million in 2005 to 6.17 million in 2030 (Gao, 2014)

The prevalence of PD per 100,000 of population varies from country to country, with highest, in Albania (800) followed by Egypt (557), USA (329-107), Israel (256), Japan (193-76), Germany (183) and more countries etc., The prevalence differs within countries. The prevalence in USA tends to differ according to race, with Hispanics,

then Whites, then Asians, then Blacks being more prone. The incidence rate of PD are newly diagnosed differs greatly according to the country. The incidence for each country, in which it is known, per 100,000 of population per year was highest in Sweden (22.5-7.9), USA (20.5-13.0), Japan (16.9-10.2), Estonia (16.8), Finland (16.6-14.9), Norway (12.6), England (12) Netherland (11.5), Russia (9.0) (Viartis, 2012).

Age is the most important risk factor for neurodegenerative disease. Gender is recognized as having an important effect on their risk and prognosis. Attention has been paid to gender differences in the frequency, causes, symptoms, treatment response and outcomes of neurological diseases (Rocca *et al*, 2014). Gender also influences disease risk, PD incidence being 1.5 times higher in men than women (Wooten *et al*, 2004). There are also gender differences in disease presentation; PD may be milder in women at early stages (Haaxma *et al*, 2007). The reasons underlying these conditions are most likely involving a combination of genetic effects, lifestyle exposure, hormonal and reproductive factors, and differences in function of the brain dopaminergic pathway (Gillies *et al*, 2014).

Environmental risk factors are exposure to pesticide and proxies which includes farming occupation, rural living and drinking well water. There is increasing evidence that individuals who suffer recurrent head injury, particularly sportspersons such as boxers, jockeys, are at risk of developing a range of degenerative neurological conditions including Parkinsonism, dementia and motor neuron disease, although pathological examination to reveal alternative pathology than that typically associated with PD (Noyce *et al*, 2012).

123I-ioflupane single-photon emission computed tomography [SPECT] (also known as DaTscan) is useful to assess the density of the presynaptic dopaminergic terminals within the striatum as it helps to differentiate PD from disorders that exist without the presence of presynaptic dopaminergic term1inal deficiency (Stoessl *et al*, 2014). F-DOPAL-6-fluoro-3, 4-dihydroxyphenylalnine (F-DOPA) positron emission tomography (PET) scan assesses the presynaptic dopaminergic integrity and accurately

reflects the monoaminergic disturbances in PD (Ibrahim *et al*, 2016). The standard magnetic resonance imaging (MRI) has a marginal role in establishing the diagnosis of PD; MRI helps to identify patients with symptomatic parkinsonism, and also helps to show specific changes in the basal ganglia and infra-tentorial structures in patients with atypical Parkinsonism (Lehericy *et al*, 2012).

Pain is present in around 60% of PD patients and occurs two to three times more frequently in this population than in age matched individuals without PD (Beiske *et al*, 2009). It is suggested that onset of PD before the age of 65 is a risk factor for pain (Negre-Pages *et al*, 2008). Pain usually occurs on the side on which motor symptoms first appear or are more severe (Ha *et al*, 2012)

Shoulder pain, commonly reported by PD patients (Barone *et al*, 2009), can be the first symptoms of PD in 2–8% of patients and might even precede the onset of motor symptoms (Wasner *et al*, 2012). Two different mechanisms: one, directly related to the neurological symptoms, is pseudorheumatic and dopamine sensitive; the other is thought to be associated with degenerative lesions that may worsen with the progression of PD (Letro *et al*, 2009).

Fear of falling (FOF) in PD is known to be a common problem affecting about 45–68% in this population (Paul *et al*, 2016). FOF is a reduction in certainty in doing activities without falling (Rahman *et al*, 2011). It may not cause disorder in daily-life by itself, but the avoidance of doing daily activities, reduction in the amount of physical activities, and increase in the risk of falling are among its serious consequences (Bryant *et al*, 2015).

Outcome Measures used are UPDRS and SF-36:

- The Unified Parkinson's Disease Rating Scale (UPDRS) was originally developed in the 1980's (Fahn *et al*, 1987), and has become the most widely used clinical rating scale for Parkinson's disease (PD) (Ramaker *et al*, 2002).

- UPDRS scale consists of Psychological status (items 1 and 4 of the UPDRS I), the daily living activities (ADL) score (items 5 and 17 of the UPDRS II), the motor score (items 18-31 of the UPDRS III, including gait and postural stability parameters), the dyskinesias score (items 32-35 of the UPDRS IV), the total UPDRS score comprised between 0 and 108, maximal worst value=108 (Altug *et al*, 2011).
- The SF-36 is an indicator of overall health status. It has 10 items with eight scaled scores; the scores are weighted sums of the questions in each section and has eight sections. Scores range from 0–100. The lower the scores the more disability, the higher the score the less disability. (McHorney *et al*, 1994).

Pharmacological treatment: Motor symptoms in PD is the depletion of striatal dopamine due to loss of dopaminergic neuron in the SNpc. Levodopa to substitute striatal dopamine is the treatment in PD. Levodopa is a standard therapy and almost all patients with PD require the treatment during the course of the illness (LeWitt *et al*, 2016).

Deep brain stimulation (DBS) is a surgical procedure for advanced PD, but it is being increasingly used for early stages of PD. It involves the stereotactic implantation of an electrode in specific brain structures (Li *et al*, 2014). The electrode is connected to pulse generator, which is implanted subcutaneously and transmits high frequency electrical impulses to the target area. The DBS settings are externally programmed via a hand-held device using an electro-modulator (Follett, 2000). DBS is a safe, cost-effective, and adjustable procedure that can be programmed to maximize motor benefits while minimizing side effects (Benabid *et al*, 1987).

Conventional Deep Brain Stimulation improves the motor symptoms of PD in both the short and long term, it is not without limitation (Janssen *et al*, 2014). Stimulation induced side effects such as dysarthria, imbalance, and dyskinesia can occur and often require regular adjustments in stimulation, especially in the first phase after surgery (Deuschl *et al*, 2006).

Core is an anatomy between the sternum and the knees with a focus on the abdominal region, low back and hips (Fig, 2005). The core muscles are transverse abdominis, multifidus, diaphragm, and pelvic floor muscles (Malatova *et al*, 2013), are thought to increase the stability of the trunk during extremity exercise and prevent injuries (Willson *et al*, 2005). Core training including the diaphragm for elderly individuals can also improve balance ability (Kang, 2015).

Core strength development programme include flexibility of the abdominal and lower back, hip extensor and flexor muscles; exercises in an unstable environment, as well as isometric and dynamic exercises (Stephenson *et al*, 2004).

OTHER POSSIBLE EXERCISES:

Behavioral Relaxation Training (BRT) has been used to successfully manage tremor of two older adults; one with essential tremor (ET) and another with ET and PD. It decreased tremor severity and improve performances in activities of daily (Chung *et al*, 1995).

Flexibility (stretching) exercise is effective at improving physical functioning, health-related quality of life (HRQOL), leg strength, walking and balance (Ellis *et al*, 2005).

Eccentric PRE training involves the use of eccentric muscle activity, that is, the active lengthening of muscles when an external load is imposed; consequently, work is done on the muscle (Lindstedt *et al*, 2001). PRE can significantly improve muscle size, muscle strength, muscle endurance, and neuromuscular function and can significantly impact areas often reported to be problematic in individuals with PD, such as bradykinesia, postural instability and patient-perceived quality of life.

Functional training-should be based on focused practice of functional skills. Overall is to improve functional mobility with specific emphasis on improving mobility of axial structures, the head, trunk, hips and shoulders. Progression to more difficult motor activities should be gradual. The more severely involved patient may benefit initially from assisted movements progressing to active movements (e.g., the PNF technique of RI) to improve initial motor performance like bed mobility skills, sitting, sit-to-stand and standing (Sullivan *et al,* 2010). The exercise benefits in improving functional capacity, gait, balance, and strength in patients in PD (Goodwin *et al,* 2008).

Balance training-program should include a variety of activities that alter task demands and expose the patient to varying environmental conditions. Adequate strength is needed to withstand the challenges of balance. The patient can be instructed in standing exercises to enhance balance, including heel-rises and toe-offs, partial wall squats and chair rises, single-limb stance with side or back kicks, and marching in place (Clark *et al,* 2010). Falls also occurs due to loss of "righting reflexes" an inability to take corrective measures to prevent fall. Patient with a backward lean develop a tendency to step backwards when they start to walk or when bumped from the front. This is known as retropulsio (Ashok Gupta, 2017).

Locomotor training-goals focus on reducing primary gait impairments, which typically include slowed speed, decrease stride length, lack of a heel-toe sequence with forward progression characterized by a shuffling (festinating) gait pattern, diminished contralateral trunk movement and arm swing, and an overall attitude of flexion while walking. Goals also focus on increasing the patient's ability to safely perform functional mobility activities and prevent falls (Morris, 2006).

Wearing orthosis immediately affecting mechanical work of walking and posture has been of great interest. Spinal orthosis also proved to improve balance quality of life and prevent falling, as well as correcting posture in patients with thoracic kyphosis (Azadinia *et al*, 2013).

Speech language therapy: National Health Service (NHS) include a lack of clarity about and control over the specifies of the style, intensity, and duration of the intervention. The Lee Silverman Voice Treatment (LSVT) was designed specifically for PD patients and focuses on a single speech feature at a time. This technique effectively increases vocal loudness and improves facial expressions in patients with PD (Deane *et al*, 2002).

Aerobic exercise promotes brain health by reducing inflammation, suppressing oxidative stress, and stabilizing calcium homeostasis (Cotman *et al*, 2007). Aerobic exercise such as treadmill training, dancing, etc., may be beneficial in improving balance, gait, physical function, and quality of life in individuals with PD (Canning *et al*, 2012).

REVIEW OF LITERATURE

[1] **Yoichi Ohno, 2018, International Journal of Physical Therapy** in the study before–after design enrolled 25 patients were participated exercise at home for 20 minutes every day, for approximately four weeks. The variables measured were walking speed, stride length, leg muscle strength, and primary impairments for PD including (UPDRS3) score as well as the maximum distance, total path length, and movement speed in a finger tapping test. A significant improvement was found in the walking speed ($p<0.05$), score ($p<0.01$), total path length ($p<0.01$). Thus conclude home based aerobic exercise therapy is effective for primary impairments in PD.

[2] **Lauren Hirsch *et al*, 2016, Journal of Neuro Epidermiology** in their study searched MEDLINE and EMBASE for epidemiologic studies of PD from 2001 to 2014. Data were analyzed for age group and gender, to determine a significant difference between groups. Significant heterogeneity was observed in 80+ group, and results that males had a higher incidence of PD in all age groups. PD incidence generally increases with age. Thus conclude PD incidence increases with age.

[3] **Ameet Kumar *et al*, 2016, Journal of Neurology & Stroke** in their cross-sectional study PD patient between the age group 50-80 of either gender enrolled for 6 months. The patient is given Beck Depression Inventory questionnaire and half an hour was given to the respondents to encircle the options. The questionnaire was administered as per the severity of the condition ranging from 0 to 3. If the sum of the encircled number was >9, then the patients are in depressed state and data was collected from the patients. Results in mean age of the total 97 patients were 65.03±11.97 years. There were 49 (50.50%) males and 48 (49.50%) female. Mean beck depression inventory score was found to be 14.65±1.47. Frequency of depression was found in (9.30%)

patients. Thus conclude prevalence of depression is observed more common among the PD patients.

[4] **Gupta *et al*, 2013, International Journal of Nutrition, Pharmacology, Neurological Diseases** in the study analyzes the research output of India in Parkinson's disease (PD) during 2002-2011 on several parameters including the growth, rank, and global publications share, citation impact, share of international collaborative papers, contribution of major collaborative partner countries, and characteristics of high-cited papers. Results in the top 20 most productive countries in PD, India ranks 16th with a global publication share of 1.47% and an annual average publication growth rate of 26.05% during 2002–2011. Thus conclude India's performance in PD is quite good in global context, and low prevalence of PD in the country.

[5] **Frederic Moisan *et al*, 2016, Journal of Neurol Neurosurgery Psychiatry** in their study used French national drug claims databases to iden1tify PD and computed male-female prevalence/incidence ratios overall and by age using Poisson regression. Ratios were regressed on age to estimate their annual change. Results in the overall male-female ratio was 1.48 for prevalence and 1.49 for incidence. The prevalence and incidence male-female ratio increased by 0.05 and 0.14, respectively, per 10 years of age. The incidence was similar in men and women under 50 years and over 1.6 times higher in men than women above 80 years. Thus concluded that age-increasing M-F ratio of PD etiology changes with age.

[6] **Maryam Mehdizadeh *et al*, 2019, Journal of Parkinson's Disease** in their study one hundred twenty-four patients with PD (mean age ± SD, 60.33 ± 12.59 years) were assessed with the FES-I, both in On- and Off-drug phases. Convergent validity of FES-I was established with Visual Analog Scale-Fear of Falling, Berg Balance Scale, and Functional Reach Test. Parkinson's Disease Questionnaire-39 and Unified Parkinson

Disease Rating Scale-Activities of Daily Living were also applied. Results in Internal consistency (α = 0.96, On phase; 0.98, Off phase) Thus conclude that FES-I is unidimensional, reliable, and valid to measure the Fear of Falling during On and Off-drug phases in people with PD.

[7] **Christopher *et al*, 2008, Journal of Movement Disorder** in their study present a clinimetric assessment of the Movement Disorder Society (MDS)-sponsored revision of the Unified Parkinson's Disease Rating Scale (UPDRS) Task Force revised and expanded the UPDRS. The MDS-UPDRS has four parts, namely, I: Non-motor Experience of Daily Living; II: Motor Experience of Daily Living; III: Motor Examination; IV: Motor Complication. Movement disorder specialists and study coordinators administered the UPDRS to patients with Parkinson's disease 39. Results in the MDS-UPDRS shows high internal consistency and correlated with the original UPDRS. The clinimetric supports the validity of UPDRS.

[8] **Riazi *et al*, 2003, Journal of Neurol Neurosurgery Psychiatry** in their study presents 227 patients with Parkinson's disease (PD). Health status was measured using the SF-36. Scores for the eight health domains were compared after controlling for age, gender, disease duration, mobility, social class, ethnicity, education, marital status, and employment status. Impact of Parkinson's disease resulted in higher scores on physical functioning and better scores in mental health when compared with Multiple sclerosis patient.

[9] **Sosipatro *et al*, 2018, Journal of Parkinson's disease** in their study conducted adult participants (>18) diagnosed with PD. The study aimed to compare the efficacy of DBS between patients with early and advanced PD. Outcomes measures were impairment/disability using the Unified Parkinson's Disease Rating Scale (UPDRS), quality of life (QOL), levodopa equivalent dose (LED) reduction, and rates of serious

adverse events (SAE). Results in significant improvement in UPDRS scores in DBS (P<0.00001) and greater reduction of LED in patients with early PD (P<0.00001), no other differences between early and advanced PD of patients were found.

[10] **Shih-Lin Hsu *et al*, 2018, The Journal of Physical Therapy Science** in their study twenty-four students were assigned to the training. They underwent 4-week training program which included exercises for the transverse abdominis, multifidus, diaphragm, and pelvic floor muscles. Results in the rectus area in the quiet sitting position with the Valsalva maneuver was enlarged and the length of trajectory during a sudden perturbation task was decreased. Thus conclude core stability was improved after 4-week training.

[11] **Duane *et al*, 2013, International Journal of Behavioral Consultation and Therapy** the study conducted single case research design on anxiety and dyskinesia of a 57-year-old female, with an 11-year history of Parkinson's disease (PD), and 18-months post deep brain stimulation of the subthalamic nucleus, were evaluated. A single-case research design with a six week follow up was used to evaluate the effectiveness of intervention. BRT resulted in systematic increases in relaxed behavior and decreased SUD rating in vivo and decrements in CAS scores. Thus conclude UPDRS assessment revealed that BRT is a valuable adjuvant behavior therapy intervention for patients with anxiety and dyskinesia related to PD.

[12] **Reuter *et al*, 2011, Journal of Aging Research** in their study 90 PD patients were randomly allocated to the 3 treatments groups. One training group performed Nordic Walking (NW) training, second group performed walking training, third group performed relaxation training 3 times per week for 6 months and each session lasted 70 minutes and consisted of a warming up and cooled down exercise. All patients were assessed by a movement disorder specialist. Results that Walking and Nordic walking

improves stride length, gait variability, maximal walking speed, and exercise capacity. Nordic Walking was superior to the flexibility and relaxation program and walking in improving postural stability, stride length, gait pattern, and gait variability.

[13] **Fabian *et al*, 2012**, **Journal of National Institute of Health** in their first randomized study compared a 10-week balance training protocol to a 10-week balance training plus PRE protocol. At the end of 10 weeks the study observed significant improvement in strength in knee extension, knee flexion, and ankle plantar flexion in the balance plus PRE group. In second study gain in strength and endurance in upper body muscles following a 12-week PRE program, and gain in strength and endurance in lower body muscles following 8-week PRE program. Results in positive changes in neuromuscular function that accompany strength gains in individuals with PD following PRE.

[14] **Alessandro Oliveira de Carvalho *et al*, 2018, Clinical Practice & Epidermiology in Mental Health** in their study shows that progressive death of dopaminergic neurons in the substantia nigra is one of the main physiological mechanisms manifested before PD, directly interfering with motor behavior. PD associated with motor symptoms, cognitive, autonomic, and mood impairments. Implementation of regular function exercise programs may exhibit potential benefits over PD. Thus conclude functional exercise contributes effectively to the

treatment of PD, and can play a role of maintaining of physical fitness and mental health.

[15] **Gharote Gaurai *et al*, 2017, Indian Journal of Medical Research and Pharmaceutical Sciences** in their experimental study conducted Parkinson's patient (n=60) of grade 1, 2, and 3 according to Hoehn and Yahr classification between age group of 50–85 years. Pre post experimental study design was selected in 2 groups

were experimental and control group each (n=30) and assessed with Fullerton Advance Balance Scale, TUG, and Modified Falls Efficacy Scale pre, 2ndweek and post. Results was found that experimental group values of pre, 2ndweek and post intervention of Fullerton Advance Balance Scale p (0.0001) TUG p (0.0001) Modified Falls Efficacy Scale value for - getting in/out of the bed p (0.0001) are extremely significant. For control group Modified Falls Efficacy Scale value for getting in/out of the bed activity are not significant. Thus conclude that balance training was effective to reduce risk of fall in Parkinson's patients.

[16] **Geunyeol Jo *et al*, 2018, The Journal of Physical Therapy Science** in their study conducted twenty-six patients with PD with gait disturbance with forward bend posture >15 degree. The patients were instructed to walk along a 6-m track and turn 180° and come back to the starting point under three-dimensional motion capture. The participants performed the test again with spinal kypho-orthosis. Gait parameters during examination is compared with and without spinal kypho-orthosis. Results that Wearing the spinal kypho-orthosis significantly improved turning performance but did not affect locomotion. The severity of forward bend posture is mildly improved after the application of spinal kypho-orthosis. Spinal kypho-orthosis has a short-term effect for gait performances, particularly during turning and erect posture. Spinal Kypho-orthosis can be potentially used for management of turning deficits in PD.

[17] **Laura Spurgeon *et al*, 2015, Rehabilitation Research and Practice** in their study included nine Parkinson's disease patients, who had undergone speech language therapy. Response of the patients were analyzed in accordance with Thematic Network Analysis Results that Four themes emerged: emotional reactions (frustration, embarrassment, lack of confidence and anxiety); practical aspects (cost of treatment, and waiting times); and expectations about treatment. Thus conclude that benefits of

speech-language therapy shows several negative issues emerged during rehabilitation and treatment plan may improve rehabilitation outcomes.

[18] **Hai-Feng Shu *et al*, 2014, Department of Neurosurgery** in systematic review evaluate the evidence about whether aerobic exercise is effective for PD. The reviewers independently extracted data and assessed methodological quality based on PEDro scale. Standardized mean difference (SMD) and 95% confidence intervals (CI) of random effects models were calculated. Results in aerobic exercise show superior effects in improving motor actions, balance, and gait in patients with PD.

[19] **Stanley John Winser *et al*, 2010, Global Journal of Health Science** in their case study 65 years old Parkinson's subject was considered. Trial was designed as a 4-week balance training program. Outcome measures were Berg's balance scale, Multidirectional reach test and CTSIB. Balance was trained by making the subject perform balance exercises standing over a square form surface which reduces the quality of surface orientation input. Training was given for 15 to 20 mins /day, 5 days in a week, for a period of 1 month. Results in 25% increase in values of FFR, BFR, LFR & RFR for multidirectional reach test. Significant improvement in Berg's balance score from 48 to 54. CTSIB assessed before the training showed a poor performance in conditions 5 & 6, post training assessment showed an improvement of 12 seconds for condition 5 and 11 seconds for condition 6. Thus conclude the balance exercise has a positive training effect on balance among subjects with Parkinsonism.

[20] **Allois Ruben *et al*, 2017, Advances in Parkinsons's Disease** in their study conducted eight elderly men with PD. The disability score was evaluated using Hoehn-Yahr scale. During the first four months, one group performed core stability exercises (CSG) while the other group exercised Balance Exercise Programe (BG). The treatment was reversed for group for last 4 months. The two groups were measured

twice, before and after the treatment. Results in CSG group shows significant variations is detected in speed of steps, step cadence, and left stride duration. Thus conclude body blance and core training is considered to be good physical exercise for people with PD.

[21] **Peter *et al*, 2018, The International Journal of Sports Physical Therapy** in their study conducted the subject with a 65-year-old male diagnosed with PD. The intervention consisted of five, two-minute bouts of walking on treadmill with lower extremity BFR cuffs interspersed with 1-minute rest, three times a week for six weeks, at 0 grade incline, and speed of 50 meters/min. A four-week baseline phase without the BFR intervention were followed. The outcome measures which were measured every two weeks over the ten weeks included: Timed Up and Go Test, 6-minute Walk Test, 30-Second Chair stand Test. Thus conclude BFR training can produce functional improvements, reduce restless leg syndrome symptoms and helps to maintain their recreational active.

[22] **Fatemeh Majdinasab *et al*, 2017, Medical Journal of the Islamic Republic of Iran** in their study conducted an experimental prospective cohort pretest-posttest group has been designed to survey patients with PD candidates for STN-DBS surgery. All participants will be evaluated by speech and language pathologist before and after surgery in four different conditions as follows: pre-surgery: Medication On/OFF; post-surgery: Stimulation ON/OFF. To compare pre-surgery and post-surgery conditions paired-samples T Test or Wilcoxon signed-rank test is used. Results in improved quality of life and expressive prosodic features with the effects of dopaminergic medications and bilateral STN DBS.

[23] **Clarissa *et al*, 2011, Arquivos de Neuro-Psiquiatria** in their study conducted with a ninety eight PD patients and 31 normal controls were analyzed. A strong correlation was found between the TMS scores and the Hoehn & Yahr staging scale (r:

0.72; p<0.01), motor Unifies Parkinson's Disease Rating Scale (r: 0.84: p<0.01) and Schwab and England Activities of Daily Living (r; -0.72; p<0.01). Results in the scale showed a satisfactory reliability rate ($\alpha_{Cronbach}$: 0.85, ICC: 099). Thus conclude that TMS is a simple and reliable instrument to evaluate trunk mobility impairment in patients with PD.

[24] **Alessandro Picelli *et al*, 2014, Journal of NeuroEngineering and Rehabilitation** in their study conducted ten patients with Parkinson's disease (Hoehn & Yahr stage 2.5–3) received ten, 45-minutes, treatment sessions, five days a week, for two consecutive weeks. Robot-assisted arm training is provided to the patients. Patients were trained with modalities like passive-passive (both arms moved by the machine) and active-active (both arms actively moving against resistance). The dominant upper limb was evaluated before and immediately after treatment as well as two weeks of follow-up. Outcomes were the nine-hole peg test, the Fugl-Meyer assessment and the Unified Parkinson's Disease Rating Scale. Results in no significant improvement was found in the Unified Parkinson's Disease Rating Scale at both post-treatment and follow-up evaluations.

[25] **Sarun Nunta-aree *et al*, Journal of the Medical Association of Thailand 2010** the study conducted twenty-seven patients with 2-year follow-up and complete data were enrolled for retrospective evaluation of Unified Parkinson's Disease Rating Scale (UPDRS) and levodopa equivalent dose (LED). Postoperative UPDRS at 6-month, 1-year and 2-year were compared with the preoperative corresponding UPDRS. Postoperative LED at 2 years was compared with the preoperative baseline. Results in 27 patients with complete 2-years follow-up, preoperative dopamine challenge test showed 50.6% improvement of motor score (UPDRS axis III). Two-year postoperative motor score during "off medication-on stimulator" showed dramatic improvement.

Thus conclude STN-DBS is a safe effective in improving activities of daily living, motor function.

[26] **Ahmed Rabie *et al*, 2016, Journal of Brain Sciences** in their study conducted with twenty patients with advanced PD who underwent bilateral STN-DBS were included. Patient were assessed preoperatively and followed up for one year using the Unified Parkinson's Disease Rating Scale (UPDRS) in "on" and "off" medication and "on" and "off" stimulation conditions. At one-year follow-up, calculated significant improvement in all motor aspects of PD (UPDRS III) and in activities of daily living (UPDRS II) in the "off" medication state. Results in "off" medication UPDRS improved by 49.3%, tremors improved by 81.6%, rigidity improved by 50.0%, and bradykinesia improved by 39.3%. The "off" medication UPDRS II scores improved by 73.8%. Thus conclude that DBS improves the cardinal motor manifestations of the idiopathic PD and the activities of daily living.

[27] **Filiz Altug *et al*, 2012, Romanian Journal of Physical Therapy** conducted a study with twenty patients who have underwent subthalamic nucleus deep brain stimulation (STN DBS) were assessed before surgery, at third month and at six months after surgery. Quality of life was assessed using SF-36 survey. Unified Parkinson's disease Rating Scale (UPDRS) was used to define severity of PD. Hoehn & Yahr Scale and activities of daily living (ADL) were also used. Results in mean age of the patients was 55.05±9.07 years. The study showed differences in ADL (p=0.000) and H&Y score (p=0.000).

[28] **Amir Abdolahi *et al*, 2013, National Institutes of Health** in their study conducted a cross-sectional and longitudinal reliability of a modified motor UPDRS compared to the standard motor UPDRS using intraclass correlation coefficients. Internal consistency of the modifies UPDRS (mUPDRS) as measured using

Cronbach's alpha, and concurrent validity was assessed using Person's correlation coefficient (r) between the standard motor UPDRS and mUPDRS. Results in high internal consistencies were ($\alpha \geq 0.96$) and high concurrent validity with the standard UPDRS ($r \geq 0.93$, $p < 0.0001$).

[29] **Ware *et al,* 1994, National Council for Osteopathic Research** studied the 8-scale profile of SF-36 which includes the section like Physical Functioning, Role Physical, Bodily Pain, General Health correlate most highly with the physical component, and contribute most to the scoring of the Physical Component Summary (PCS) measures. Vitality, Social Functioning, Role Emotional, Mental Health correlate most highly with the mental component, and contribute most to the scoring of the Mental Component Summary (MCS).

[30] **McHorney *et al*, 1994, National Council for Osteopathic Research** studied the data quality, scaling assumptions and reliability across diverse patient. Analyses were collected in patient and diagnosis, and disease severity was assessed. For each scale, item-completion rates were higher between (88% to 95%). All scales passed tests for item-internal consistency (97% passed) and item-discriminant validity (92% passed). Reliability coefficients ranged from a low of 0.65 to a high of 0.94.

AIMS AND OBJECTIVES

AIM OF THE STUDY: The study aims at improving the ability of balance in Parkinson's Disease with Deep Brain Stimulation (DBS).

NEED OF THE STUDY: Due to greater extent of Parkinson's disease and its adverse effect on the activities of daily living an effective exercise is needed for Parkinson's disease.

OBJECTIVES OF THE STUDY: To analyze the efficacy of core strengthening exercises in Parkinson's disease.

HYPOTHESIS

NULL HYPOTHESIS:

Core strengthening exercises is effective in improving body balance and postural control.

ALTERNATIVE HYPOTHESIS:

Core strengthening exercises is not effective in improving body balance and postural control.

MATERIALS & METHODOLOGY

STUDY DESIGN: Single case study

STUDY SETTING: This study was carried out at outpatient department of Sree Balaji College of Physiotherapy BIHER, Chennai.

DURATION OF STUDY: Nov. 2018 to Apr. 2019

SELECTION CRITERIA:

INCLUSION CRITERIA:

- A level of 3 on the Hoehn and Yahr scale
- A diagnosis of idiopathic Parkinson patient
- Bilateral STN DBS patient (idiopathic PD)
- The patients were followed up for at least 3 months
- Freezing of Gait.

EXCLUSION CRITERIA:

- Neurological diseases (ataxia, cerebral vascular accident, dementia etc.)
- Severe dyskinesias or “on-off” fluctuations
- Brain atrophy
- Severe uncontrolled psychiatric illness or depression
- Doubtful diagnosis of PD

ASSESSMENT TOOL:

Unified Parkinson Disease Rating Scale (UPDRS) was used to assess the ability of patients for doing daily living activities and Medical Outcomes Study Questionnaire Short Form 36 Health Survey (SF-36) was used to assess the quality of life (QOL).

Unified Parkinson's Disease Rating Scale (UPDRS):

UPDRS was used to define severity of the Parkinson's disease. Patients were clinically assessed using the UPDRS. Different scores were extracted from different scale.

Sections:

- the psychological status (items 1 and 4 of the UPDRS I)
- the daily living activities (ADL) score (items 5 and 17 of the UPDRS II)
- the motor score (items 18 to 31 of the UPDRS III)
- the dyskinesias score (items 32 to 35 of the UPDRS IV)

Reliability:

The mUPDRS versus standard motor UPDRS is cross-sectionally (ICC≥0.92) and longitudinally (ICC≥0.92) (Amir Abdolahi *et al*, 2013).

Validity:

The mUPDRS had high concurrent validity with the standard UPDRS and longitudinally ($r \geq 0.93$, $p < 0.0001$) (Amir Abdolahi *et al*, 2013).

Score Interpretation:

- 100% = Completely independent. Able to do all chores without slowness, difficulty or impairment.
- 90% = Completely independent. Able to do all chores with some degree of slowness, difficulty and impairment.
- 80% = Completely independent in most chores.
- 70% = Not completely independent. More difficulty with some chores.
- 60% = Some dependent. Can do most chores.
- 50% = More dependent. Help with half, slower, etc.
- 40% = Very dependent. Can assist with all chores, but few alone.
- 30% = With effort, now and then does a few chores alone or begins alone.
- 20% = Nothing alone. Can be a slight help with some chores.
- 10% = Totally dependent, helpless.
- 0% = Vegetative function such as swallowing, bladder and bowel functions are not functioning. Bed ridden.

Medical Outcomes Study Questionnaire Short Form 36 Health Survey (SF-36):

The SF-36 is an indicator of overall health status. It includes 10 items.

Scoring:

The SF-36 has eight scaled scores; the scores are weighted sums of the questions in each section. Scores range from 0–100.

Lower scores = more disability, higher scores = less disability.

Sections:

- Vitality
- Physical functioning

- Bodily pain
- General health perceptions
- Physical role functioning
- Emotional role functioning
- Social role functioning
- Mental health.

Reliability:

The reliability of the SF-36 has exceeded 0.80 with the reliability in the physical and mental sections typically above 0.90 (McHorney CA *et al*, 1994).

EVALUATION

History:

Subject aged 54 years old male diagnosed as idiopathic Parkinson's disease and treatment with Bilateral STN DBS.

Complaints:

Walking and standing difficulties, loss of balance, difficulties in ADL activities.

On Observation:

Stooped posture, difficulty in turning, short shuffling gait, unable to do tandem walking, poor heel to toe pattern.

On Examination:

Waist Circumference: Pre – 106cm

Post – 97cm

PROCEDURE:

- The subject 54-year male treated with core strengthening exercise, 2 times a week for a duration of 30 minutes for 6 months.
- First 3 months involves 5 sets of core strengthening which includes 10 exercises for each sets and done 5 repetitions a day.
- The progression is carried for the next 3 months involves 5 sets of core strengthening which includes 10 exercises for each sets and done 10 repetitions a day.

Exercises:

- Pelvic bridging with single leg raising supported on swiss ball under the knee joint in supine lying.
- Pelvic bridging with both legs raising supported on swiss ball under the ankle joint in supine lying.
- Knee extension with ball resistance in supine lying.
- Pelvic tilt with swiss ball between both the legs in side lying.
- Reverse leg raising using ball under the abdominal region in prone lying.
- Full plank using ball under the ankle joint.
- Rolling forward and backward movement in swiss ball in sitting position.
- Sitting upright in the swiss ball and extending the hands upwards.
- Sitting upright in the swiss ball and extending the hands sideways.
- Upward pushups in swiss ball in sitting position.

RESULTS

Table of Results on UPDRS score using Subject 't' Test

SCALE	MEAN		SD	SE	T	P
	PRE	POST				
UPDRS	32.35	16.17	9	5.22	3.10	0.01

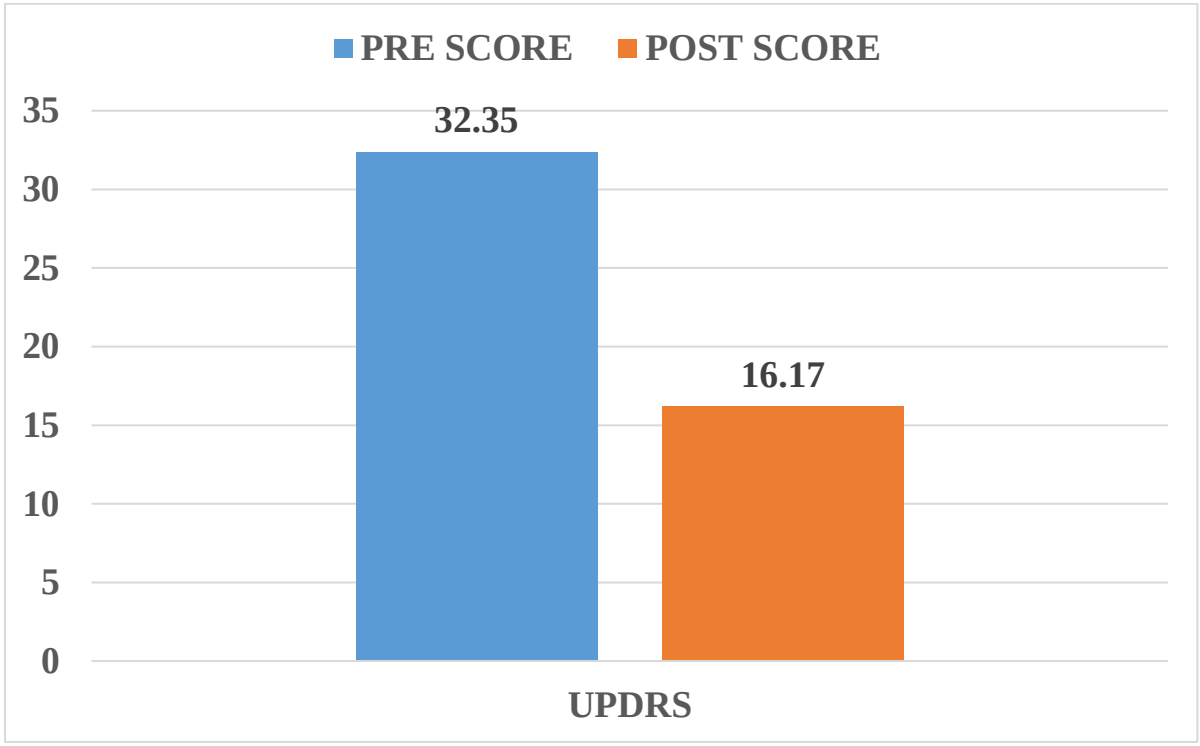
The Subject showed improvement in balance ability, risk of fall has decreased and significant improvement in activities of daily living after 24 weeks of Core Training.

INTERPRETATION:

From the above mentioned table the value of Unified Parkinson's Disease Rating Scale shows a mean value of 32.35 & 16.17 and standard deviation of 9, standard error of 5.22 with a t-value of 3.10 and highly significant of ($p<0.01$).

COMPARISON OF MEAN VALUE BETWEEN GROUP A & GROUP B

CHART - I



DISCUSSION

Parkinson's Disease patients frequently present impaired postural control that leads to loss the stability and increased risk of falls. Core system, includes passive structures of the thoracolumbar spine and pelvic that work as a unit to stabilize the body and the spine against forces generated from distal body segments as well as forces generated from expected or unexpected perturbations.

Marras *et al* 2018 observed in the study that the lower prevalence estimate differences in environment or genetic risk factors. Individuals 70–79 years of age in Asia were found to have a significant lower prevalence of PD compared with individuals of the same age in Europe, North America and Australia.

Ameet Kumar Talreja *et al* 2016 in the study report that prevalence of depression in PD was found 9.30%. The prevalence of depression in the current study was less as compared to usually study .20% to 50% of patients with PD are considered to have major depression. Several risk factors are severity of cognitive impairments, onset of parkinsonian symptoms before age 40 and a history of depression prior to diagnosis of PD.

Xu *et al* 2014 in the study found that male patients had slightly increased mortality risk over female patients. Males have been shown to have earlier onset that women. Mortality which occurs earlier also offset the increased incidences in males.

Diem-Zangerl *et al* 2019 in the study also observed a significantly higher standardized mortality rates (1.3, 95% CI 1.1 -1.6) for males with PD vs the general population, but not for females (1.1, 95% CI 0.9 -1.4).

Frederic Moisan *et al* 2016 in the study reported PD incidence to be approximately 1.5 times higher in men than women. Age related gender differences in number of cases with individual studies was generally small and age related limitation often restricted to persons 65 years and older.

Gharote Gaurai *et al* 2017 reported patients with PD have abnormalities of posture and balance. If the disease progresses, abnormal and inflexible postural responses along with increased body sway. Narrowing of the base of support or competing attentional demands increases postural instability. Patients are unable to perceive upright or vertical position, which may indicate an abnormality.

Allois Ruben *et al* 2017 report subjects with PD report increased difficulty in maintaining balance not only during static situations, but also in dynamic one and in the transition phase between static and dynamic state during transitions between static and dynamic.

Shih-Lin Hsu *et al* 2018core strength is important to improve body balance and postural control in movements such as landing and contact. Core strengthening training is supposed to improve stability of the trunk.

Beratto Luca *et al* 2017 core stability and balance training can be useful for people with PD. Training protocol based on balance control can improve the ability to manage dynamic balance and strength.

Thus conclude that core strengthening exercises is more effective in improving ability of balance in Parkinson's Disease with Deep Brain Stimulation.

LIMITATIONS & FURTHER RECOMMENDATIONS

- The study has its own limitation with a number of single case study so that the further studies can be done with a more number of patients.

- It is also recommended to study the long term follow up of core strengthening exercises in Parkinson's patients.

- It is a case study but this can also be done as experimental study.

CONCLUSION

Core strengthening exercises were more effective in subject with Parkinson's Disease. Greater efficiency of movement, improved body control and balance with reduced risk of injury (the core muscles act as shock absorbers for jumps and rebounds etc.) and also improved balance and stability.

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APPENDIX – I

CONSENT FORM

I there by here with give my letter of consent to participate in the study undertaken by on . I am explained with purpose, limitations and benefits.

Date:

Place:

Signature of the Participant/Subject

APPENDIX – II

APPENDIX – III

NEUROLOGICAL PHYSIOTHERAPY EVALUATION FORM

I. Subjective Assessment

Name: Age: Gender: M/F IP/OP

Occupation: Handedness: R/L Referred

by: Address:

Chief Complaints:

Past Medical History:

Personal History:

Family History:

Socioeconomic History:

Symptoms History:

Side: Site:

Onset: Duration:

Type: Severity:

Aggravating

Factors: Relieving

Factors:

Vital Signs:

Temperature:		Heart Rate:	
Blood Pressure:		Respiratory Rate:	

II. Objective Examination

a) ON OBSERVATION:

Attitude of limbs:

Built:

Posture:

Gait:

Pattern of

Movement: Mode

of Ventilation:

Type/ Pattern of

Respiration: Oedema:

Muscle Wasting:

Pressure Sores:

Deformity:

Wounds:

External Appliances:

b) ON PALPATION

Warmth:

Tenderness

: Tone:

Swelling:

c) ON EXAMINATION

HIGHER MENTAL FUNCTIONS

Memory:

Immediat

e: Recent:

Remote:

Verbal:

Visual:

Communication:

Cognition:

Fund of

Knowledge:

Calculation:

Proverb

Interpretation: Attention:

Emotional

Status:

Perception:

Body Scheme/ Body

Imaging: Agnosias/

Apraxias:

Special Senses:

Cranial Nerves:

Nerves	Comments	Nerves	Comments
I – Olfactory		VII - Facial	

II – Optic		VIII - VestibuloCochlear	
III – Oculomotor		IX - Glossopharyngeal	
IV - Trochlear		X - Vagus	
V - Trigeminal		XI - Accessory	
VI - Abducent		XII - Hypoglossal	

SENSORY SYSTEM

Location	Upper Extremity		Lower Extremity		Trunk		Comments
Sensation	Rt.	Lt	Rt.	Lt.	Rt.	Lt.	
Superficial							
Pain							
Temperature							
Touch							
Pressure							
Deep							
Mov. Sense							
Pos. Sense							
Vibration							
Cortical							
Tactile Localization							
2 pt. discrimination							
Stereognosis							
Barognosis							
Graphesthesia							
Texture Recognition							
Double Simultaneous Stimulation							

MOTOR SYSTEM:

Muscle Girth:

Area	Rt.(cm.)	Lt.(cm.)
Arm		
Forearm		
Thigh		
Calf		

Voluntary Control:

Side	Rt.	Lt.
Upper Limb		
Lower Limb		

Range of Motion:

Joint	Side	Movement	Limitation	Limiting factor
Shoulder				
Elbow				
Forearm				
Wrist				
Hand&Fingers				
Hip				
Knee				
Ankle & foot				

Limb Length

Side	Rt.(cm.)	Lt.(cm.)
True		
Apparent		

Muscle Tone:

Muscles	Rt.	Lt.
Shoulder		
Flexors		
Extensors		
Abductors		
Adductors		
External Rotators		
Internal Rotators		
Elbow		
Flexors		
Extensors		
Forearm		
Pronators		
Supinators		
Wrist		
Flexors		
Extensors		
Radial Deviators		
Ulnar Deviators		
Hand		
Intrinsics		
Extrinsics		

Muscles	Rt.	Lt.
Hip		
Flexors		
Extensors		
Abductors		
Adductors		
External Rotators		
Internal Rotators		
Knee		
Flexors		
Extensors		
Ankle		
Dorsiflexors		
Plantarflexors		
Foot		
Invertors		
Evertors		
Intrinsics		
Extrinsics		

Muscle Power:

Muscles	Rt.	Lt.
Shoulder		
Flexors		
Extensors		
Abductors		
Adductors		
External Rotators		
Internal Rotators		
Elbow		
Flexors		
Extensors		
Forearm		
Pronators		
Supinators		
Wrist		
Flexors		
Extensors		
Radial Deviators		
Ulnar Deviators		
Hand		
Intrinsics		

Muscles	Rt.	Lt.
Hip		
Flexors		
Extensors		
Abductors		
Adductors		
External Rotators		
Internal Rotators		
Knee		
Flexors		
Extensors		
Ankle		
Dorsiflexors		
Plantarflexors		
Foot		
Invertors		
Evertors		
Intrinsics		
Extrinsics		

Trunk Flexors		
Trunk Extensors		
Trunk Side Flexors		
Trunk Rotators		

Reflexes:

	Reflex	Left	Right
Superficial	Abdominal		
	Plantar		
Deep	Biceps		
	Brachioradialis		
	Triceps		
	Knee		
	Ankle		

Coordination:

Non Equilibrium Tests	Rt.	Lt.
Finger to nose		
Finger opposition		
Mass Grasp		
Pronation/Supination		
Rebound test		
Tapping (Hand)		
Tapping (Foot)		
Heel to knee		
Drawing a circle(Hand)		
Drawing a circle(Foot)		

Equilibrium tests	Grade
Standing: Normal Posture	
Standing: Normal Posture with vision occluded	
Standing: Feet together	
Standing on one foot	
Standing: Lateral trunk flexion	
Tandem walking	
Walk: Sideways	
Walk: Backward	
Walk in a circle	
Walk on heels	
Walk on toes	

Systems Review:

INTEGUMENTARY SYSTEM

CARDIOVASCULAR SYSTEM

MUSCULOSKELETAL SYSTEM

BLADDER & BOWEL FUNCTIONS

GASTROINTESTINAL SYSTEM

AUTONOMIC SYSTEM

Functional Assessment: (The Functional Independence Measure) Evaluation 1: Selfcare

Evaluation 2: Sphincter control

Evaluation 3: Mobility

Evaluation 4: Locomotion

Evaluation 5: Communication

Evaluation 6: Social adjustment/cooperation

Investigation Findings:

Problem List:

Functional Diagnosis:

Goals: Short term:

Long term:

Treatment: