



THE COMPARATIVE STUDY TO DETERMINE THE EFFECTIVENESS OF OTAGO EXERCISE PROGRAMME VERSUS PILATES EXERCISE PROGRAMME ON BALANCE AND PREVENTION OF RISK OF FALL ON PARKINSON'S PATIENTS.

¹Dr. Nidhi K Patel, ²Dr. Hiral Solanki, ³Dr. Gaurav Patel, ⁴Dr. Viral Shah

¹Postgraduate physiotherapy Student, ²Assistant professor at Ahmedabad physiotherapy college, ³Principal at Ahmedabad physiotherapy college, ⁴MPT-Neuro

¹Ahmedabad physiotherapy college, Parul university, Vadodara, India.

Abstract: BACKGROUND : Parkinson's disease is a progressive disorder of central nervous system characterized by both motor and non motor symptoms. Motor symptoms include four cardinal features of rigidity, bradykinesia, tremor, and in later stages postural instability. The purpose of this study is to find out the efficacy of Otago exercise programme versus Pilates exercise programme for improve balance and prevention of risk of fall in patients with Parkinson's disease. **METHODOLOGY:** 30 Parkinson's disease patients with age group between 50 to 65 years were included. They were randomly allocated in 2 groups. Group A received Otago exercise programme and Group B received Pilates exercise programme. Warm up and cool down are same in both groups. Balance was measured by The Fullerton Advanced Balance scale (FAB) and Activity Specific balance confidence scale (ABC) before and after 6 weeks of intervention. **RESULT:** Result were statistically analyzed using t test by using SPSS version 23. There was significant improvement in with <0.001 in group A and group B. In between Group, there was more significant improvement in FAB and ABC with $p < 0.001$ in Group B than Group A. **CONCLUSION:** This study showed a significant improvement in efficacy of Group B on balance in Parkinson's patients as compared to Group A. This study concluded that Pilates exercise programme is more effective than Otago exercise programme on balance in older adults to prevent falls.

KEY-WORDS: Parkinson's, balance, Otago, Pilates, FAB, ABC

I. INTRODUCTION:

Parkinson's disease was first described as "the shaking palsy" by James Parkinson's in 1817. Parkinson's disease is a progressive disorder of central nervous system characterized by both motor and non motor symptoms. Motor symptoms include four cardinal features of rigidity, bradykinesia, tremor, and in later stages postural instability. Non-motor symptoms may proceed after onset of motor symptoms by years.¹

Parkinson's disease is a chronic progressive neurodegenerative disorder.² 50 to 60 years is the average age of onset. PD is a common disease that affect an estimated 7 to 10 million people worldwide.¹ PD has increased more than double in past two decades from 2.5 million patients in 1990 to 6.1 million patients in 2016 worldwide according to Global Burden of Disease study. As estimated in 2016 in India 0.58 million people are living with PD.²⁷ More than 2% of older people who are more than 65 years of age have PD.¹

Parkinsonism is a generalized term used to explain a group of disorder with primary disturbances in dopamine system of basal ganglia. Approximately 78% of patients are affected by idiopathic Parkinsonism which is the most common form of disease. A number of different identifiable causes resulting in secondary Parkinsonism which include viruses, drugs, tumors of BG, toxins, vascular diseases and so forth. Less than 10% of cases affected by genetic forms of PD overall. Several gene mutations have been identified in a small number of families (e.g., PARK1, DJ-1, PINK1, LRRK2, and glucocerebrosidase, among others). Genes have been categorized in two groups: 1) Associated genes, which do not cause PD but increase the risk of developing it. 2) Causal genes, which actually develop the disease.¹

A collection of interconnected grey matter nuclear masses deep within the brain are called the Basal Ganglion (BG). The Basal Ganglia is a network of subcortical nuclei. It is consisting of the putamen, the globus pallidus, the caudate nucleus and the subthalamic nucleus along with substantia nigra. A number of parallel circuits or loops are engaging by the BG. There are both direct and indirect loops. Through BG the direct motor loop consists of signals transmitted from the cortex to putamen to globus pallidus, to the thalamus and back to cortex. Thus the BG via a positive feedback loop serves to activate the cortex and assist in the initiation of voluntary movement. An indirect loop consists of the sub-thalamic nucleus, the globus pallidus interna, and substantia nigra pars reticulata to the superior colliculus and midbrain tegmentum. This indirect loop work for decrease thalamocortical activation and it provides inhibition of some movements.¹ Parkinson's disease is explained by (1) degeneration of dopaminergic neurons that produce dopamine in the Basal ganglia in the pars compactus of the substantia nigra. (2) There is presence of cytoplasmic inclusion bodies called 'lewy bodies' are found as the disease progresses and neurons degenerate. Before onset of motor symptoms substantial neurodegeneration occurs in PD with clinical signs emerging at 30% to 60% degeneration of neurons.¹ A key pathological structure in PD is the basal ganglia which is associated in controlling the flexibility of postural tone, selecting postural strategies for environmental context, automatizing postural responses and gait.³³

In PD motor symptoms include the cardinal features bradykinesia, tremors, rigidity and postural instability. Non motor symptoms include constipation, sleep behavior disorder, loss of sense of smell, rapid eye movement, mood disorders and orthostatic hypotension which are early symptoms of PD. Other than that excessive saliva, integumentary changes, altered bladder function, difficulty in speaking and swallowing and cognitive problems like slowed thinking, confusion and in some cases dementia is also included.¹

Balance can be explained as control of the body's center of mass over its base of support in order to achieve postural equilibrium and orientation. Balance control requires integrate information from all levels of the musculoskeletal and nervous system via active brain processes, not only while walking but also while standing still.³³

Frequent fall and fall injuries are the reason of growing disease. The adoption of a stooped, flexed posture with increased flexion of neck, trunk, hips and knees are coming up with weakness of antigravity muscles which results in significant change in center of alignment position and the forward limit of stability while positioning individual.¹ Due to axial rigidity patients with PD present limited trunk flexibility which is showed in the co-contraction of the trunk and hip muscles, contributed to impaired movement coordination and impaired selectivity that alter balance.²⁵

Falls are significantly leads to disability, reduced quality of life and lost independence of people with Parkinson's disease. Prospective studies shows that each year between 45% to 68% of patient with PD will fall and 50%-86% report recurrent falls.²⁶ There are many risk factors for falls in Parkinson's patients which include postural instability, lower limb weakness, disease severity, poor leaning balance, gait impairment including freezing, rigidity, and cognitive impairment.^{1, 26} That leads to balance impairment and increase risk of fall.

The Otago exercise programme was developed by professor John Campbell and his research team at the university of Otago medical school, New Zealand. The Otago exercise programme is a generally concentrated at improving balance, strength and gait with falls rate reduction reported On average 35% in community dwelling older.²⁵ It includes set of lower limb muscles strengthening exercises and balance training exercise with progression by number of sets and increasing ankle cuff weights.⁶ The Otago exercise programme helps in standing upright, control body and walking when it moves in a compact range of area.²⁵ The OEP is improving balance by including higher order balance mechanism and sensory re-weighting and by peripheral sensory inputs, mostly from the proprioceptive, visual and vestibular system.³

In 1926 Joseph Pilates was establish a method of exercise called Pilates. Pilates is designed to strengthen, stretch and balance body.⁵ Each exercise repeated a few time. So the body is constantly being exposed to new muscular and kinesthetic challenges.²³ Pilates helps in restoring balance by creating proper physiological adaptations and by increasing motor cortex plasticity, skill leaning, improving the use of muscles.⁵ Pilates concentrated on breath control, postural symmetry, abdominal strength, muscular flexibility, shoulder, spine and pelvis stabilization, joint strengthening and mobility through full range of motion. It helps to prepare whole body by integrating the upper and lower limb with trunk. Pilates exercise has great power to improve various motor abilities.⁵ Pilates is focuses on the most effective motor units recruitment which places the emphasis on energy efficiency and quality of performance.²³

The Fullerton Advanced Balance (FAB) Scale: In 2006 the Fullerton advanced balance scale was developed by Rose and Lucchese to evaluate static and dynamic balance under different sensory conditions in older adult population. This scale is useful to evaluate the musculoskeletal, sensory and neuromuscular system that might cause balance disorders. This multidimensional scale was designed to identifying that contributing factors to impair balance. Advantages of this scale include ability to predict falls in higher functioning older adults by high level of balance evaluation. This scale is having scoring depending on subject's performance between 0 and 40. Each task's score is 0-4, where 0 suggests inability to perform the balance task and 4 suggests that subject ability to accomplish the task properly and totally independently. The total score is the value of summation of the ten sections' score.⁵ A test-retest reliability for this scale is 0.98.²²

Activity Specific Balance Confidence (ABC) Scale: The ABC scale was created to assess an individual's confidence in her/his capability to perform daily activities without falling. This scale was created to use for older adults. To evaluate postural performance it is important to assess fear of falling. Activity restriction mediated by the fear of falling will deteriorate the balance. It is ordinal scale having 16 items which scoring from 0-1600 possible. The final score is recorded as percentage where highest level of confidence is 100%. Maximum score of 1600 is divided by 16 items=100%. This scale is clinically registered for working on the patient's confidence in their balance as well as other balance activities.³ This scale's test-retest reliability is 0.93 and internal consistency is 0.95.³⁴

II. METHODOLOGY:

All of the subjects were required to meet the following inclusion criteria: (1) Patient with Parkinson's disease. (2) Patient with age group of 50 to 65 Years. (3) Gender: Both males and females. (3) No previous diagnosis of vestibular dysfunction. (4) Sufficient cognitive ability to participate, as indicated by MMSE score of 24 or higher. (5) Patient with balance impairment (The Fullerton Advanced Balance scale < 24). Exclusion criteria: (1) Patient with too advanced disease were excluded (Modified Hoehn & Yahr > 4, Unified Parkinson's Disease Rating Scale-RIGIDITY > 3). (2) If patients had any other physical disabilities or medical conditions which affecting their mobility. (3) If patient rejected to participate in the study. (4) Medication's side effects.

All the subjects were assessed with FAB scale & ABC scale before and after the 6 weeks by following intervention. Group A received otago exercise programme for 6 weeks. Strengthening exercise was given by set of 10 repetition of each exercise. Balance retraining exercise's magnitude was increased by increasing repetition of the exercise and increasing the complicity of exercises. The intensity was increase by increasing set or by adding weight. The exercise session was given for 45 minutes per session for 3 days per week for six weeks.

Otago exercise programme:

Strengthening exercises:

- knee extensors
- knee flexors
- hip abductors
- ankle dorsi flexors
- ankle planter flexors

Balance retraining exercises:

- knee bends
- backward walking
- walking and turning around
- sideways walking
- tandem stance
- tandem walk
- one leg standing
- heel walking
- toe walking
- heel toe backward walking
- sit to stand
- stair walking

Group B received pilates exercise programme. The exercise session was given for 45 minutes per session for 3 days per week for six weeks. The magnitude was increased by increasing repetition of the exercises and by increasing holding time.

Pilates exercise programme:

- one leg stretch
- shoulder bridge
- trunk rotation
- trunk lateral bending
- oblique curl up
- knee fold scissors
- torpedo
- prone trunk extension
- prone leg lift
- semi squats
- front\ side splits
- one leg stance

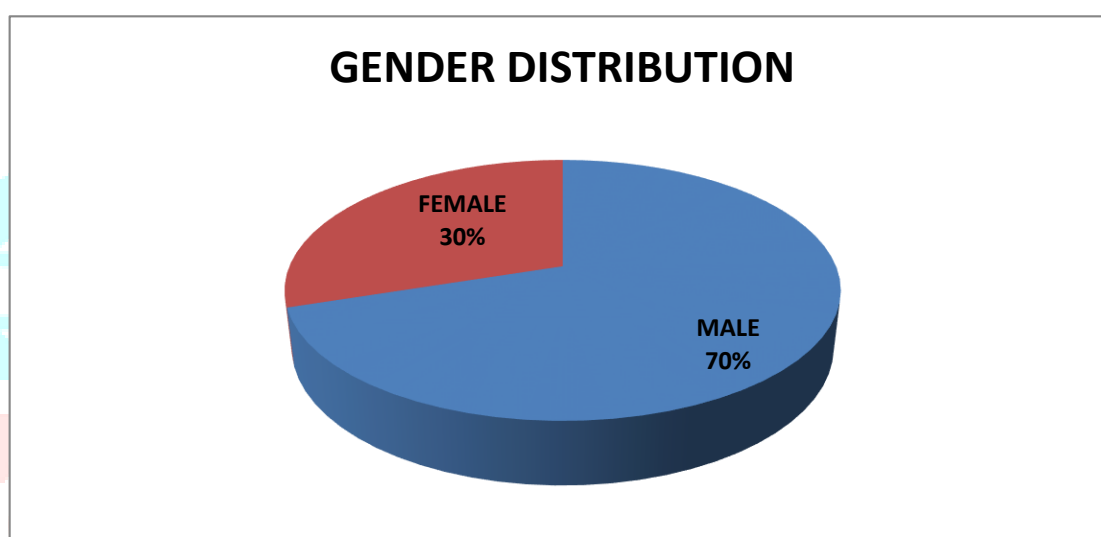
Through SPSS version 23 the collected data were analyzed. Parametric test is analyzed statistically because of normal distribution. The collected demographic values were compared between and within the groups with p value < 0.001 using paired and unpaired t test.

III. RESULT:

In this study 30 patients (minimum age was 45 years and maximum age was 65 years) having Parkinson's were included out of which 23 were male and 7 were female.

	GROUP A (n=15)	GROUP B (n=15)
AGE	60.67± 3.15	61.2±2.73
GENDER (M/F)	11/4	10/5

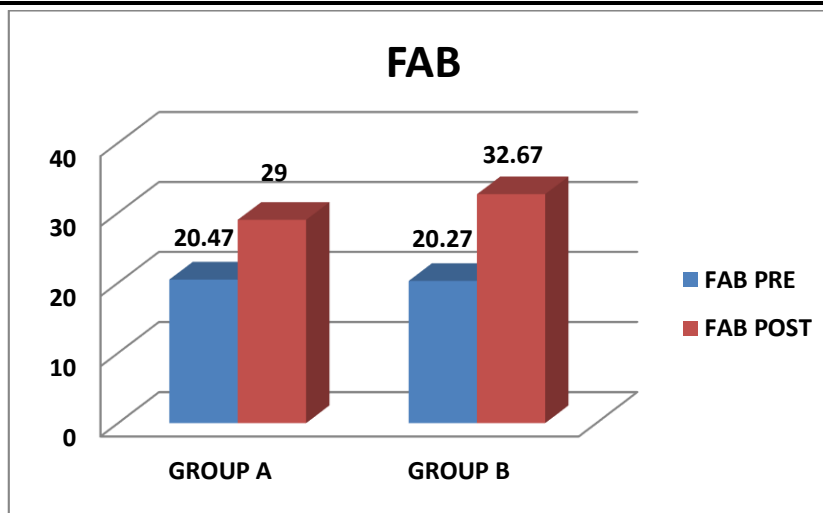
TABLE 1.1: MEAN AGE AND GENDER DISTRIBUTION IN GROUP A AND GROUP B



GRAPH 1.1: GENDER DISTRIBUTION

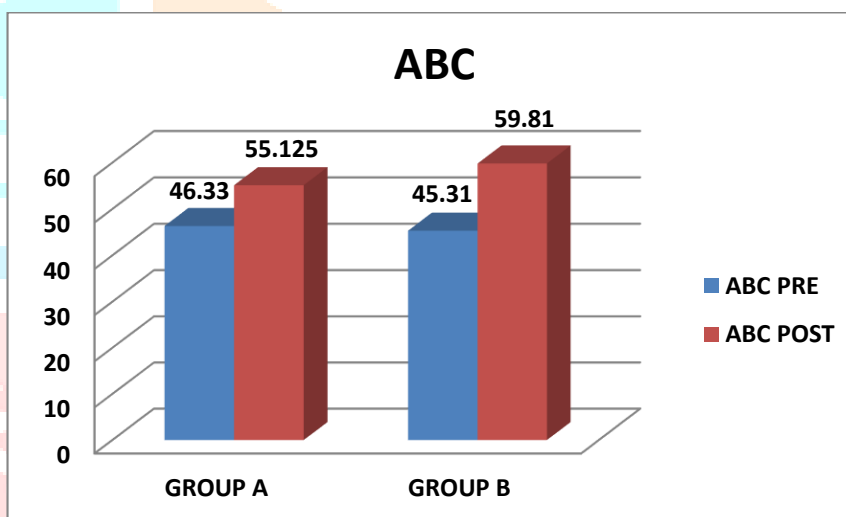
OUTCOME	GROUP A		GROUP B	
	PRE	POST	PRE	POST
FAB	20.47	29	20.27	32.67
ABC	46.33	55.12	45.31	59.81

TABLE 1.2: COMPARISON OF MEAN WITHIN AND BETWEEN THE GROUPS
GROUP A: OTAGO EXERCISE PROGRAMME
GROUP B: PILATES EXERCISE PROGRAMME



GRAPH 1.2 COMPARISON OF MEANS OF FAB BETWEEN GROUPS (COMPARISION OF PRE AND POST TEST)

The above graph shows comparison of pre-post data of FAB between two groups. Paired t-test was used and p value is <0.001 . So, statistical proven that There was a significant difference in both the group A and B but Group B showed more significant improvement than Group A.

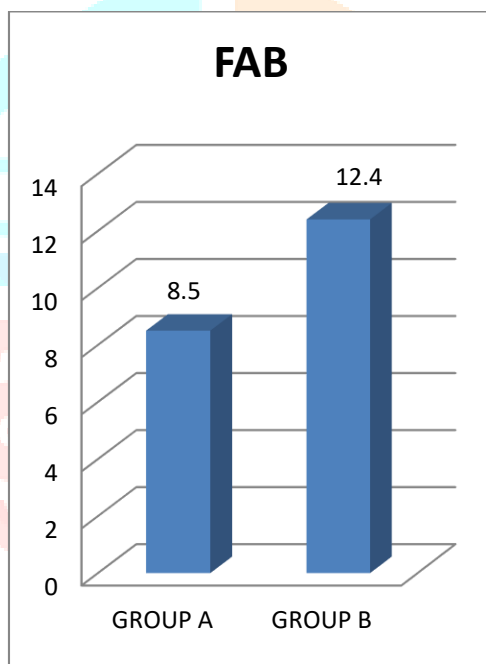
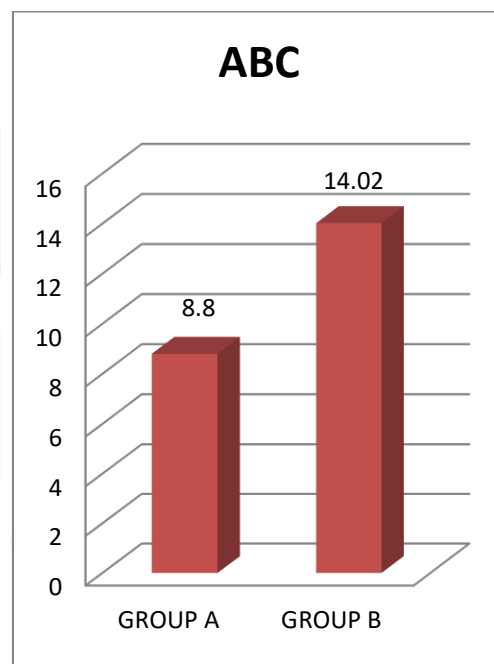


GRAPH 1.3 COMPARISON OF MEANS OF ABC BETWEEN GROUPS (COMPARISION OF PRE AND POST TEST)

The above graph shows comparison of pre-post data of ABC between two groups. Paired t-test was used and p value is <0.001 . So, statistical proven that There was a significant difference in both the group A and B but Group B showed more significant improvement than Group A.

TABLE 1.3: BETWEEN THE GROUP COMPARISON

OUTCOME	MEAN \pm SD	UNPAIRED- T TEST	P VALUE
FAB GROUP A	8.53 \pm 1.50	8.15	<0.001
FAB GROUP B	12.4 \pm 1.05	8.15	<0.001
ABC GROUP A	8.79 \pm 1.91	4.93	<0.001
ABC GROUP B	14.02 \pm 3.65	4.93	<0.001

1.4 FAB BETWEEN GROUPS**1.5 ABC BETWEEN GROUPS**

UNPAIRED t-test was used to analyses of inter-group data. When comparison was done between both the groups, GROUP A FAB PRE-POST=8.5 and GROUP B FAB PRE-POST=12.4, GROUP A ABC PRE-POST=8.8 and GROUP B ABC PRE-POST=14.02. So, significantly greater improvement was observed in Group B. These statistics mean that Pilates exercise programme is more effective to improve balance and prevention of risk of fall in Parkinson's patient.

IV. DISCUSSION:

Purpose of this study is to evaluate the efficacy of Otago exercise programme versus Pilates exercise programme on improving balance and prevention of risk of fall in Parkinson's patients.

Result of the study showed Otago exercise programme and Pilates exercise programme both are individually and statistically significant improvement in balance and prevention of risk of fall in Parkinson's patients but Pilates exercise programme(Group B) showed more significant effects as compared to Otago exercise programme(Group A) .

Both the groups were assessed for balance and prevention of risk of fall by using The Fullerton Advanced Balance Scale (FAB) & Activity Specific Balance Scale (ABC) as an outcome measure.

Dr. Niyati N. Patel, et al (2017) had done an interventional study to assess the effect of Otago exercise on balance and gait affection in patient with Parkinson's disease. 20 patients with Parkinson's disease with age group from 45-65 years were included. All the Parkinson's patients received a 6 weeks protocol of Otago exercise. They used Berg balance scale and dynamic gait index as outcome measure. This interventional study showed significant improvement in both outcome measures and it provided evidence to support the otago exercise.²

The OEP includes set of lower limb muscles strengthening exercises and balance training exercise with progression by number of sets and increasing ankle cuff weights.⁹ It is improving balance by including higher order balance mechanism and sensory re-weighting and by peripheral sensory inputs, mostly from the proprioceptive, visual and vestibular system.³

Youngju et al (2016) had conducted a study to know the effect of Otago exercise program on fall efficacy, activity of daily living and quality of life in elderly stroke patients. Eight subjects performed the Otago exercise program three times per week for eight weeks. The outcome measure was fall efficacy scale score for fall efficacy. They considered that Otago exercise program is an effective method for improving fall efficacy in elderly stroke patient.¹⁶

In this study, Group A was given 45 minutes Otago exercise programme. After intervention balance and prevention of risk of fall was measures by FAB Scale and ABC Scale. The result of pre-intervention mean score of FAB =20.47 and ABC=46.33. Post-intervention mean score of FAB =29 and ABC =55.12. So, this shows difference of 8.53 in FAB and difference of 8.8 in ABC within the group. So, there is significant difference in balance and prevention of risk of fall within the group.

Bakhshayesh Babak et al(2017) have conducted a RCT study to know effects of Pilates exercises on functional balance in patients with Parkinson's and concluded that given that Pilates exercise affects both the muscular and the nervous system so they can well treat balance disorders emerging especially in patients with postural control disorders.⁸

Pilates concentrated on breath control, postural symmetry, abdominal strength, muscular flexibility, shoulder, spine and pelvis stabilization, joint strengthening and mobility through full range of motion. It helps to prepare whole body by integrating the upper and lower limb with trunk. Pilates exercise has great power to improve various motor abilities.⁵

Dr. Shailja Pandya and Dr. T. Nagendran, et al (2017) performed an interventional study to know Pilates Training Program effect in participants with Idiopathic Parkinson's disease on Balance. 30 subjects with Idiopathic Parkinson's disease of age group <65 years were included. They divided in two groups. Group A received with Conventional Physiotherapy and Group B received with Pilates exercises with Conventional Physiotherapy for 7 weeks. BBS, Activity Specific Balance Confidence Scale (ABC) and Timed- Up- and Go Test (TUG) were measured before and after treatment as outcome measure. The study conclude that Pilates Intervention with Conventional Balance Training is more effective than Conventional Balance Training alone.³

Khalil Alavi, et al (2020) had performed an interventional study to check the effects of Tai-chi and Pilates on the balance of elderly Parkinson's men. 45 subjects were included in the study and then divided in two group Tai chi and Pilates training with one control group. Subjects were evaluated with BBS Kurtzke expanded disability status scale (EDSS) and physical activity readiness questionnaire (PAR-Q) before and after 12 weeks of intervention. According the result of this study static balance is improved by Pilates because of its greater impact.²⁹

David Suarez-Iglesias et al (2019) had done a systemic review and meta analysis and concluded that Pilates practice could have a positive impact on fitness, balance and physical function. Its benefits on lower body function appear to be superior to those of other conventional exercises.⁴

In this study, Group B was given 45 minutes Pilates exercise programme. After intervention balance and prevention of risk of fall was measures by FAB Scale and ABC Scale. The result of pre-intervention mean score of FAB =20.27 and ABC=45.31. Post-intervention mean score of FAB =32.67 and ABC =59.81. So, this shows difference of 12.4 in FAB and difference of 14.5 in ABC within the group. So, there is significant difference in balance and prevention of risk of fall within the group.

In Group A and Group B, mean difference of FAB & ABC in Group A is 8.53& 8.8 respectively and mean difference of FAB & ABC in Group B is 12.4 and 14.5 respectively. So, this shows Group B was more effective rather than Group A. Group A FAB $p < 0.001$ and Group B FAB $p < 0.001$. Group A and Group B intergroup significance $p < 0.01$. This reveals that there is significance difference between Group A and Group B. So, null hypothesis is rejected.

From the above literatures, it is proved that Otago exercise programme and Pilates exercise programme both are effective to improve balance in Parkinson's patients. But according to obtained result, the study confirmed that 6 weeks of Pilates exercise programme is significantly more effective in improving balance and prevention of risk of fall in Parkinson's patients. As in comparison Group B shows greater percentage of improvement than Group A.

V. CONCLUSION:

Otago exercise programme and Pilates exercise programme both showed significant improvement on balance and prevention of risk of fall in Parkinson's patients. But Group B showed greater significant difference as compared to Group A. So study result suggests that Pilates exercise programme is more beneficial than Otago exercise programme to improve balance and prevention of risk of fall in Parkinson's patients.

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