Measurement of effectiveness of pnf and balance training on gait and balance in older adults

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Abstract

Study design: Pretest - Post test experimental design

Objectives: Older adults or elderly are the human beings who are going through the process of ageing, which represent as accumulation of changes comprising physical, psychological and social changes. Walking is the most efficient functionwhich declines with ageing. In this study we aimed to evaluate effect of two exercise program on balance and gait.

Methods : In this study 40 subjects of age 60-75 years of age who have difficulty in walking were participated and allocated into two group PNF group(n=20) and balance training group(n=20).One group was treated with PNF training and other group with balance training by biodex for 4 weeks. Outcome measures were timed up and go test, berg balance score and gait parameters which were assessed before and after the intervention.

Results: Result of the study shows that both the intervention are highly effective in improving Berg balance score and timed up and go score. Both the intervention are also effective in improving gait parameters such as cadence, average speed which improves the mediolateral margin of stability and backward margin of stability.

Conclusion: Both the interventions are effective to improve balance and gait among older adults.

Keywords: Biodex, PNF

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PNF is an approach to therapeutic exercise that combine functionally based diagonal pattern to the technique of neuromuscular facilitation to evoke motor responses and improve neuromuscular control and function. PNF techniques are used to develop muscular strength and endurance, facilitate stability, mobility, neuromuscular control and coordinate movement[1]. Proprioceptive receptors present in muscles, tendons and joints are the special sensors sensitive to stretch or pressure helps in awareness of position of feet and legs by sending Proprioceptive inputs to brain. Proprioceptive cues from the ankles determine the body's movement or sway relative to standing surface (hard, soft, and slippery). Using this Proprioceptive inputs brain

sends feedback information to muscle and joint to move and make the adjustments to body position to maintainbalance and coordination

Balance is an ability to maintain centre of gravity on base of support[5].Balance plays a major role in walking and it is the primary contributor of stable walking. Older adults needs to put more attention on the complex task of walking if not, they are at risk of fall which is likely followed by serious injuries. Internal factors related with fall injuries are divided into physical and psychological factors; physical factors include decrease muscle strength of the lower extremities, and decreased gait ability, balance ability, grip strength, and sensory motor adjustment, and sensory decline like vision and psychological factor and depression, anxiety and fear. Decrease in muscle strength is the main contributory factor for balance and gait disability resulting from aging. Muscle strength decreases about 25% - 30% after the age of 60, and such muscle strength weakness results in decrease in the entire muscle fibers and the size[26, 27].

The incidence of fall in the elderly ranges from 25% to 35%, and the probability of recurrent falls in people with a history of falls is 52%. In India, the prevalence of falls among older adults aged 60 years and older was 14% to 53% [9]. The WHO reported that the fall-related mortality rate for India is 2.1 per 100,000 people. A basic aim of exercise science is to improve the function of a system through exercise; the exercise must stimulate that system.. Many rehabilitation programs are put together for older adult which involve strength training, balance training, gait training, yoga, tai chi to improve balance and physical fitness in older adult. With advancement of technology, advanced equipment Biodex balance system is used for balance training. It is a multi-axial device used for treatment and assessment of balance and stability. Biodex balance system assist patient in controlling their centre of gravity over base of support. The instant biofeedback system makes it easy for the patient to relate to and repeat the motions, also it provide safe controlled environment.

METHOD

Participants

The study population is a representative sample of the population living in the New Delhi, India.

The protocol was approved by the ethical committee of Jamia Hamdard University, New Delhi and participants signed informed consent.

Inclusion criteria

Age- 60 -75years, Able to walk with or without aids, having difficulty in walking and balancing, MMSE score 24 or more, Berg balance score 45 or less, MMT score 3 or more

Exclusion criteria

Not able to walk, Subject with severe sensory deficit, any deformity (scoliosis, genu varum, genu valgum, equinus), any vestibular disorder

Groups

Subjects selected for research were allocated into two groups, group A and group B each group having 20 subjects.

Outcome measures

Gait parameters - step length, stride length, stance phase, swing phase, cadence, gait cycle, speed
Balance - Berg balance score, Timed up and go score, Modified fall efficacy scale.

Forty subject of age between 60-75 years was selected on the basis of inclusion and exclusion criteria and divided into two groups, 20 subjects in each group; and the informed consent have been signed by each the subjects.Pre intervention evaluation is done by gait analysis on OPTOGait photoelectric system, Berg balance score, timed up and go test, modified fall efficacy questionnaire.

- Group A (experimental group1) receive lower limb PNF training along with lower limb stretching 4 times a week for 4 weeks
- Group B (experimental group2) receive lower limb strengthening exercise along with balance training given by Biodex balance trainer 4 days a week for 4 weeks.

Post intervention evaluation is done after 4 weeks by taking gait parameter on OPTOGait photoelectric system, Berg balance score, timed up and go test, modified fall efficacy scale.

Comparison between the pretest and posttest readings to evaluate the changes in gait parameter, berg balance score, timed up and go test and modified fall efficacy scale.

Training

Group A(experimental group) receive lower limb PNF diagonal pattern along with stretching of lower limb muscle exercise 4 times a week for 4 weeks.

Diagonal pattern of lower extremity.

- D1 flexion : flexion-adduction-external rotation
- D2 flexion : flexion-abduction-internal rotation
- D1 extension :extension -abduction and internal rotation
- D2 extension *:* extension-adduction-External rotation

Technique[46]

- Rhythmic initiation
- Dynamic reversal
- Combination of isotonic

Each movement is practiced 10 times with each technique with 2 minutes rest between each technique.

Group B (experimental group2) –balance training on biodex balance trainer.

- Postural stability training
- Weight shift training
- Percent weight bearing training **Conventional training -**
- stretching of lower limb muscles (hamstring, calf, adductors)
- static quadriceps 10 rept
- Dynamic quadriceps exercise 10 rept with 10 sec hold
- Straight leg raise 10 rept with 10 sec hold
- Abductor strengthening in side lying
- Hip extensors strengthening in prone

DATA ANALYSIS

Statical analysis was done by SPSS software. ANOVA (One-way Analysis of Variance) followed by Tukey-Kramer Multiple Comparisons Test to compare the pre and post readings.

Results

A total of 40 subjects were included in the study according to the inclusion criteria by sample of convenience. They were allocated into 2 groups namely group A (PNF) group and group B (balance training) group.

Result is not statically significant due to less number of patient.

Discussion

This study compares the effect of PNF training and balance training on gait parameter and Balance in older adult of age 60-75 years.**Step length –** Step length in group A in which PNF training has been given decreases in both left (50.31±2.16-48.45±2.6) with 3.6% variation and right (50.09±2.65 - 49.77±2.87) with 0.63% variation between the pre and post training readings. Step length in group B in which balance training has been given on biodex balance trainer decreases in right (48.85±1.88 - 47.77±1.56) with 2.21% and increases in left (47.21±2.23 - 50.70±2.72) with 3.49% variation .There may be small difference between left and right limb parameter. Right and left limb are not mirror images of one another[12].

Stride length - Stride length in group A in which PNF training has been given decreases (99.14±4.65 -97.59±4.68) with 1.56% variation and Stride length in group B in which balance training has been given on biodex balance trainer decreases (96.06±3.67 - 94.20±2.82) with 1.93% variation .

Cadence – cadence in group A increases (88.3±3.96 - 90.51±3.84**)** with 2.50% variation and cadence in group B also decreases (90.97±4.01 - 89.94±5.14) with 1.13% variation. There is very minimal variation from its pre value in group B considered as no change from pre value.

Average speed -Average speed in group A increases (0.65±0.05 - 0.66±0.04) with 1.53% variation and Average speed in group B in decreases (0.72±0.03 0.67±0.05) with 6.9% variation .

Step length, Stride length and cadence can be different at a particular speed, studies says that an increase in cadence (stride frequency) and a decrease in stride length minimize the risk of falling.[2]Laura Hak et al in his study says thatmediolateral margin of stability (ML MOS) increases with increase in cadence (stride frequency) and backward margin of stability (BW MOS) increases with decrease in stride length and increase in walking speed[2,3,4]. The margin of stability (MOS)is the distance between the extrapolated COM (XCOM) and the edge of an individual's BOS in which the XCOM represents the state of the COM taking into account both its position and velocity. MOS can be calculated in medio-lateral (ML) and backward (BW) direction. The ML MOS is the minimum distance in medio-lateral direction between the extrapolated centre of mass and the lateral border of the foot attained during foot-contact.The BW MOS is the distance in anterior-posterior direction between the XCOM and the posterior border of leading foot at initial contact

The result of this study proves that PNF training improves medio-lateral and backward margin of stability by decrease in stride length, increase in cadence and increase in walking speed. Michael S. Orendurffet al in his study says that mediolateral centre of mass displacement decreases with increased speed and vertical centre of mass increases with increased speed.Walking speed is the function of both cadence and step length and increase in either cadence or step length contribute to increase walking speed[5].D. D. Espyet al also through his study defined that shortening of step length with increase in gait speed has effect on maintenance of stability from slip onset to recovery of lift off. In his study he also says that faster gait and shorter step length ameliorate the risk of fall when slip occur by maintaining stability from slip initiation to lift off of recovery foot[6].

Berg balance score (BBS) – the BBS score in group A increases (40±1.17 - 45.6±0.96) with 14% of variation Pvalue-0.001 and in group B also increases (42.22±0.98-47.22±0.80) with 11% variation P value - 0.005.

Berg balance score increases in both the group it signifies that balance ability of the patient improve by both the PNF training and balance training but its highly improved in group A(PNF training group) and mildly increased in group B.The reason of mild increase in BBS is less number of subjects in balance training group.

TUG – Timed up and go test score in group A decreases with (18.05±1.52 - 14.75±1.42) and variation 18.2% and in group B also timed up and go score decreases with mean deviation (15.22±0.73 - 12.44±0.44) with variation 18.26%. The result of this study suggest that after intervention timed up and go score decreases in both the group which indicate that subject in both group have improved balance and decrease fall risk **Stance phase and swing phase –**

stance phase in both the group increases in group A in left leg (62.76±2.07 - 69.64±2.02) with 2.06% variation in right leg (67.96±1.78 - 66.55±1.46) with

-11% variation and in group B in left leg increases (65.90±3.01 - 68.22±1.34) with 3.27% variation in right leg (67.26±2.88 - 69.46±2.84**)** with 3.5% variation.

The swing phase decreases in group A left leg (35.93±1.91 - 29.09±1.60) with 19.03% variation increases in right leg (29.81±1.61 - 32.15±0.91)and group B decreases in left leg (34.16±3.05 - 33.04±1.85) with 12.06 variation increases in right leg (31.32±2.78 - 32.27±3.10**)** with 1.52% of variation. In both the group swing phase increases in right leg and decreases in left leg. Though gait is a symmetrical event but variation can be there in both the leg.

Gait cycle – gait cycle time increases in both the groups in group A (1.34±0.05 - 1.50±0.13**)** with variation in group B (1.33±0.04 - 1.39±0.09) with variation.

Gait cycle, stance phase and swing phase –Gait cycle is the duration of entire cycle which include stance phase and swing phase. Gait cycle is characterized by two brief periods of double limb support each lasting 10% of gait cycle in which both limbs are in contact with the ground. Stride duration is similar to gait cycle duration, the stance phase is similar to stance time, and the swing time is similar to swing phase. Stance time is the amount of time that passes during the stance phase of one extremity in a gait cycle. It includes single support and double support phase. Swing time is amount of time that passes during the swing phase of one extremity in a gait cycle. If the stride time of gait cycle is 1sec the stance time is 0.6sec and swing time is 0.4sec. The result of the study suggest that stride length decreases but gait cycle time increases that means though the stride length decreases but stride time increases which indicate that subject taking more time to balance before initiating swing phase or preparing for swing phase.

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MFES – modified fall efficacy scale score increases in both the group in group A (113.2±4.37 - 114.4±4.18) with variation in group B (116.61±2.29 - 119.77±2.20**)** with variation

COMPARISION BETWEEN THE GROUPS

. Both the technique is equally effective in berg balance score, timed up and go test and modified fall efficacy scale. Increase in gait cycle duration, average speed, cadence have more improved in subjects in group A that is in PNF technique group as compared to Group B. Berg balance score is highly effective in Group A and mildly effective in Group B it may be due to less number of patient in group B.Timed up and go score and MFES is improved in both but highly improved in group B than Group A.

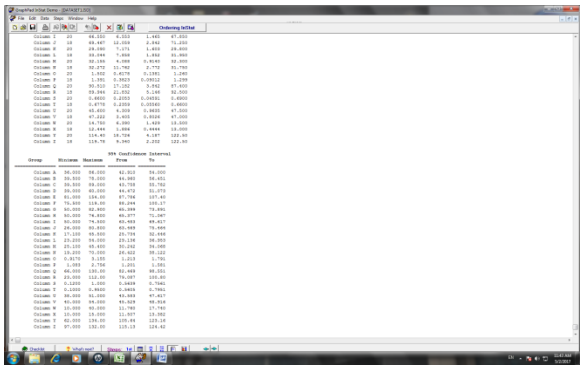
Conclusion

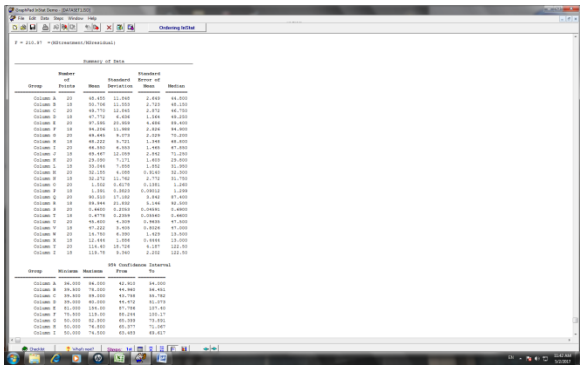
The results of this study demonstrate that changes in gait parameter occur through PNF training such as cadence, speed, step length and stride which contribute to improve mediolateral MOS and backward MOS. The balance training may also have same effect but due to less number of subjects, statically significant values have not been found in these parameters. Both PNF and balance training by biodex balance system had great improvement in BBS and TUG score this suggests that both the intervention are highly effective for improving balance among the older adults.

In both the group the desired improvement has not been found in stance and swing phase of gait parameters, it may be because the training period was short (4 weeks) continued training may further improve these parameter.

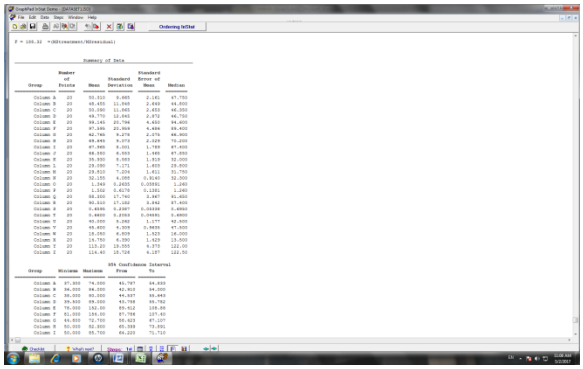
Thus this proves the alternate hypothesis of the study that is there is significant improvement in gait parameter and balance in elderly people

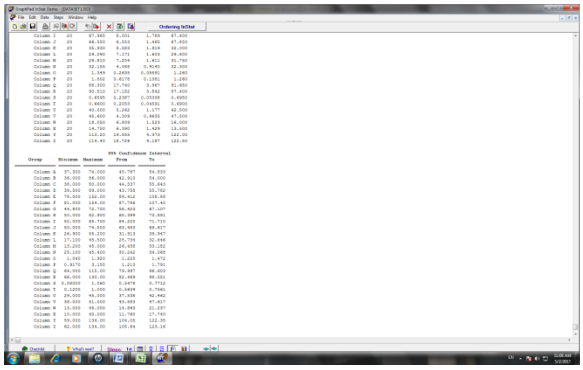
Group A&B





Group A





Group B