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Which one is better, multi-sensory approach or Proprioceptive Neuromuscular Facilitation on improving functional mobility and dynamic balance in elderly

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Abstract
Question: Which one is better, multi-sensory approach or Proprioceptive Neuromuscular Facilitation on improving functional mobility and dynamic balance in elderly.
Design: Comparative.
Duration: 4 weeks.
Methodology: A total of 30 convenient elderly either sex aged ≥60 yrs (14 female, 16 male) were recruited and randomized equally in two groups to treat either with PNF (Group A) or Multisensory approach (Group B) were selected on the basis of fulfillment of inclusion criteria**.** Data from prior work suggested that a minimum of 7 subjects in each group would be required to meet the statiscal power.(15)
Result: The readings of the outcome measures dynamic balance were measured with SEBT. Prior to training, both the Group A and Group B demonstrated similar performance on the SEBT in the measured variables. Following the interventions, the SEBT composite score of all eight reach directions in both groups and limbs increased (improved) at post and the improvement was evident higher in Group A than Group B and right limb than left limb.
Conclusion: This study concluded that both groups had an improvement in the dynamic mobility as measured in SEBT scores. But only the PNF technique obtained statistically significant gains after four weeks of intervention. However, when comparing both the interventions, there was no statistically significant difference.

Keywords: SEBT, PNF, balance

Introduction

Aging is the natural process. Ageing is generally defined as a process of deterioration in the functional capacity of an individual that results from structural changes, with advancement of age [1]. Balance is maintained by multiple systems (vestibular, visual and somatosensory) that must acton the musculoskeletal system to produce postural changes [14]. Postural control decreases with age. The greatest decrease in balance in 60- 70 years old women occurs with eyes closed during a single limb stance. Age related effects on balance have been found at 40 years of age [14]. Postural- control and balance can be grouped into static and dynamic categories.

Static postural control tasks requires the individual to establish a stable base of support and maintain this position while minimizing segment and body movement during this assessment [5]. These assessments can be conducted with instrumented equipment, such as force platforms, or valid, reliable clinical scales such as the balance error scoring system or Berg Balance Scale [5]. Conversely dynamic postural control involves some level of expected movement around a base of support to create a purposeful movement without compromising the established base of support [5]. Studies have shown that dynamic balance decreases with age [14]. For these reasons, individuals who are 50 years old may start to experience manifestations of imbalance and body instability. Therefore, simple activities like standing up or rising up from a chair become limited or even dangerous, because they are dependent on both gait and balance [9].

A very challenging test used primarily in athletic populations is The Star Excursion Balance Test (SEBT). The SEBT could be used, for example, in high – level traumatic brain injury (TBI) clients who require more demanding test condition [26]. However, although there is evidence for the validity and reliability of this test in orthopedics populations, as yet this test has not been investigated for use in neurological populations [26].

A dynamic postural-control task that has gained notoriety in the clinical and research settings is the Star Excursion Balance Test (SEBT). The SEBT is a functional screening tool that is used to assessed dynamic stability, monitor rehabilitation progress, assess deficits following an injury, and identifying atheletes at high risk for lower extremity injury [15, 17]. First, the task of maintaining in-place balance (ie, "static" balance during standing and sitting) is different from maintaining balance when a person is moving from point A to point B [6]. Dynamic balance tests have been developed to predict fall risk primarily in elderly [14]. There are less common dynamic test for older adult: rapid step test, alternate step test, lateral rhythmic step test, and side step [14].

Researchers have suggested that, with appropriate instruction and practice by the individual and normalization of the reaching distances, the SEBT can be used to provide objective measures to differentiate deficits and improvements in dynamic postural-control related to lower extremity injury and induced fatigue, and it has the potential to predict lower extremity injury [12]. The SEBT requires lower extremity coordination, balance, flexibility, and strength [15].

The SEBT requires multiple neuromuscular characteristics that may render it a more effective test to identify athletes who are at greater risk for lower extremity injury. Hertel *et al*., simplified the test and through factor analysis found that the posteromedial reach direction identified individuals with chronic ankle instability compared to healthy controls. The SEBT also requires other neuromuscular characteristics such as lower extremity coordination, flexibility, and strength. Furthermore, each reach direction activates muscles to a different extent. Earl and Hertel, found that each reach direction activated the stance lower extremity muscles to a different extent.

The aim of this study is that with appropriate instruction and practice by the individual and normalization of the reaching distances whether the SEBT can assess improvements in dynamic postural control after Exercise interventions [30]. The SEBT requires lower extremity coordination, balance, flexibility, and strength [15]. So far no research has been done in elderly populations till date to compare the effecton SEBT performance scores in between multisensory exercises and PNF on elderly populations.

Methodology

Subjects

A total of 30 convenient elderly either sex aged ≥60 yrs (14 female, 16 male) were recruited and randomized equally in two groups to treat either with PNF (Group A) or Multisensory approach (Group B) were selected on the basis of fulfillment of inclusion criteria. Data from prior work suggested that a minimum of 7 subjects in each group would be required to meet the statiscal power [15].

Inclusion Criteria

- Older than 60 years [5, 12].
- No Vestibular Disorders [5, 12].
- No ankle injury sustained in the past 2 years (minor or major) [5, 12].
- No prior balance training [5, 12].
- No upper respiratory or ear infections [5, 12].

Exclusion Criteria

- Cerebral Concussions [5, 12].
- Vestibular Disorders [5, 12].
- Ankle injury sustained in the past 2 years (minor or major) [5, 12].
- Prior balance training or any sort of regular training in the last three months [5, 12].
- Upper respiratory or ear infections [5, 12].
- Cardiovascular diseases [5, 12].
- Psychiatric or neurological disease diseases [5, 12].

Sampling Method

Convenient sampling sory exercises and PNF on elderly population.

Study Design

Comparative Study

Study Duration

4 weeks

Procedure

Prior to testing, subjects were received and signed a consent formed approved by SANTOSH MEDICAL COLLEGE which stated how the subjects rights would be protected. Initial testing included all demographic testing and height measurement were taken. Subjects were interviewed to determine prior injury history. Subjects were randomly assigned intotwo groups (GROUP A- PNF, GROUP B- Multisensory Approach) 15 subject in each group and participated for 4 weeks of training. Post training testing was done after 4 weeks before giving intervention of techniques, warm – up exercise was given.

Warm-up period [9]:

- shortwalks
- gameswithballsusingthehandsorfeet.
- stretchingexercisesforhipmuscles,flexors, andextensorsoftheknee,ankle, andparaspinalmuscles.
- Resistance exercises for plantar flexors and dorsiflexorsas well as squatting and abdominals were performed against gravity in order to strengthen lowerlimbs and trunk

Threeseriesof10repetitionswereperformedforeachoftheseexercises. (9)

Group a. Pnfinterventions [28, 13]

PNF exercise program consist of 3 sessions per week for 4 weeks. Each session will be lasting for 45 minutes whereas eight different movement patterns will be used (table 6. 1) they will be used on both limbs. The physiotherapist will be conducting all training session where maximum manual resistance will be applied; the resistance progression trough the 4 weeks will be carried out according to PNF principles using Rhythmic Stabilization. Rythymic stabilization manual contacts are applied both agonist and antagonist muscles, with resistance given simultaneously. The subject is asked to hold the contraction against graded resistance. Without allowing the patient to relax, manual contacts are switched to opposite surfaces in the following pattern.

Table 1: Strengthening Exercises Using PNF

	Initial position	Final position
D1-fl D2-fl D3-fl D4-fl D1-ext D2-ext D3-ext D4-ext	H extension, abduction and internal rotation; K flexion A flexion and eversion; F flexion and adduction. H extension, abduction, and internal rotation; K extension A flexion and eversion; F flexion and adduction H extension, abduction and internal rotation; K flexion A flexion and inversion; F flexion and abduction H extension, abduction, and internal rotation;K extension; A flexion and inversion; F flexion and abduction H flexion, adduction and external rotation; K extension A dorsiflexion and inversion; F extension and abduction H flexion, adduction and external rotation; K extension A dorsiflexion and inversion; F extension and abduction H flexion, abduction and internal rotation; K extension A dorsiflexion and eversion; F extension and abduction H flexion, abduction and internal rotation; K extension A dorsiflexion and eversion; F extension and abduction H flexion, abduction and internal rotation; K extension A dorsiflexion and eversion; F extension and abduction	H flexion, adduction and external rotation; K extension A dorsiflexion and inversion; F extension and abduction. H flexion, adduction and external rotation; K flexion A dorsiflexion and inversion; F extension and abduction H flexion, adduction and external rotation; K extension A extension and eversion; F extension and adduction H flexion, adduction and external rotation; K extension A dorsiflexion and eversion; F extension and adduction H extension, abduction and internal rotation; K flexion A flexion and eversion; F flexion and adduction H extension, abduction and internal rotation; K flexion A flexion and eversion; F flexion and adduction H extension, adduction and external rotation; K extension A flexion and inversion; F extension and adduction H extension, adduction and external rotation; K flexion A flexion and inversion; F extension and adduction H extension, adduction and external rotation; K flexion A flexion and inversion; F extension and adduction

Fifteen repetitions with three rest period [18] in between.

Group b. Multisensory approach [9]

Subjects performed activities to stimulate the plantar surface and dynamic balance:

- They were asked to walk varied distances forward, backward, and sideways, both with open and closed eyes, and at different speeds.
- Ground surfaces were varied, including mattresses. They we real so challenged with obstacles like ropes, cones, andsticks.
- According to the subject's ability asked to remain standingonuni-orbipedal support, and with open or closed eyes.

These sensorial challenges lasted 20 to 30 minutes. Training of Motor Coordination was performed with alternate movements of upper and lower limbs with different positions of head and neck, and with and without visual stimuli.

Performance of Functional Mobility Using Star Excursion Balance Test

The length of the stance leg was measured from the anterior-superior iliac spine to the most distal point of the ipsilateral medial malleolus, using a standard tape measure while participants lay supine on a plinth. A verbal and visual demonstration of the SEBT was given to participants.

Participants performed the SEBT by standing in the middle of a testing grid with strips of tape placed at 45' angles, reaching with 1 foot as far as possible along the different grid lines, and then returning to the starting position. The goal was to have the individual establish a stable base of support on the stance limb at the apex of the testing grid and maintain support through a maximal reach excursion in multiple directions. While standing barefoot or in socks on a single limb and keeping the hands on the hips, the participant made an effort to reach as far as possible with the reaching limb along each tape measure; touch lightly on the tape measure with the most distal portion of the reaching foot, without shifting weight to or coming to rest on the foot of the reaching limb; and return the reaching limb to the start position at the apex of the grid, resuming a stable bilateral stance. Standardized oral instructions were given to every participant as follows [30]:

Oral Instructions Given for Star Excursion Balance Test Performance [30].

- ''Keep your stance foot flat on the floor with your hands on your hips.''
- ''Make a reach with your other leg as far as possible and make a light tap on the measuring tape.''
- ''Without pushing off the ground with your reaching leg, return it back to the center of the testing grid and place this foot on the ground next to the foot of the stance leg.''
- ''You may make any movements you wish to reach as far as possible, as long as you keep your stance foot planted, your hands on your hips.''
- ''If you tap more than once or slide the reaching foot during the reach, miss the tape measure with your tap, push off the floor with the reaching foot, lift your heel or your hands from the testing position, or are unable to return the reaching foot back to the starting position, we will repeat that trial.''

Trials were discarded if the examiner felt that [50].

- The subject lifted the stance foot from the centre of the grid.
- Subject lost his/her balance.
- Subject did not touch the line with the reach foot while continuing to fully weight bear on the stance leg.

Statistical Analysis

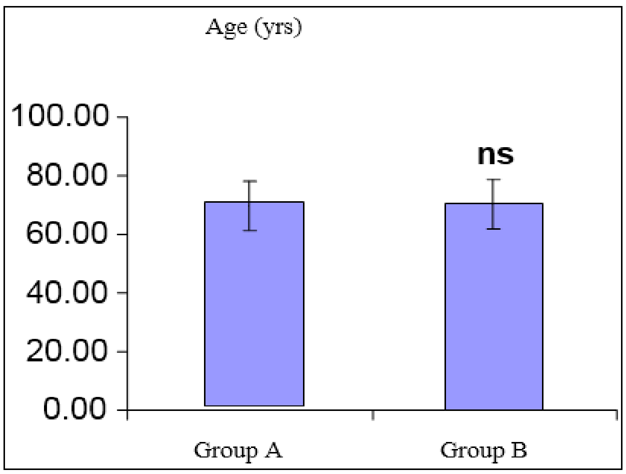
Data were summarized as Mean ± SD. The effect of three factors viz. group (PNF and Multisensory approach), period (pre test and post test) and limb (left and right) on SEBT scores (functional mobility i.e. maximum reach distance of eight directions viz. anterior, anteromedial, medial, posteromedial, posterior, posterolateral, lateral and anterolateral, and their composite score) of elderly was analyzed by 3 way mixed model analysis of variance (ANOVA) and the significance of mean difference within and between the groups was done by Tukey post hoc after ascertaining normality by Shapiro-Wilk test and homogeneity of variances by Levene's test. The age and limb length of two groups were compared by independent Student's t test. Gender proportion of two groups was compared by chi-square (χ^2) test. A two-sided (α=2) p value less than 0.05 ($p<0.05$) was considered statistically significant.

Results

a. Basic Characteristics

Table 2: Basic characteristics of two groups

Characteristics	Group A (n=15)	Group B (n=15)	P value
Age (yrs):			
Mean ± SD	69.60 ± 8.57	70.13 ± 8.41	0.865
Range (min to max)	(60 to 85)	(60 to 87)	
Gender:			
Males	8 (53.3%)	8 (53.3%)	1.000
Females	7 (46.7%)	7 (46.7%)	
Limb length (inch):			
Mean ± SD	34.40 ± 2.00	35.40 ± 1.84	0.166
Range (min to max)	(30 to 38)	(32 to 40)	



$^{ns}p>0.05$- as compared to Group A

Fig 1: Mean age of two groups

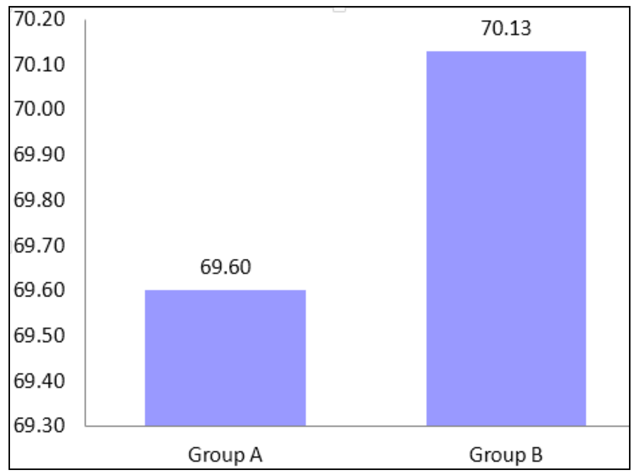
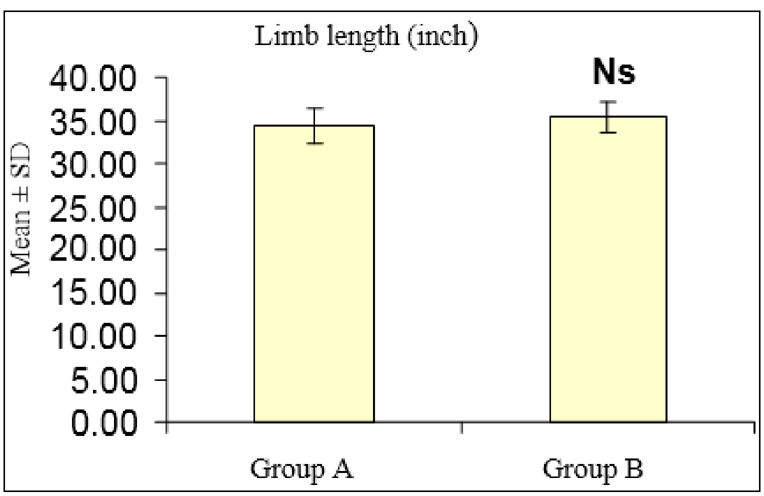


Fig 2: Gender distribution of two group



$^{ns}p>0.05$- as compared to Group A

Fig 3: Mean limb length of two groups.

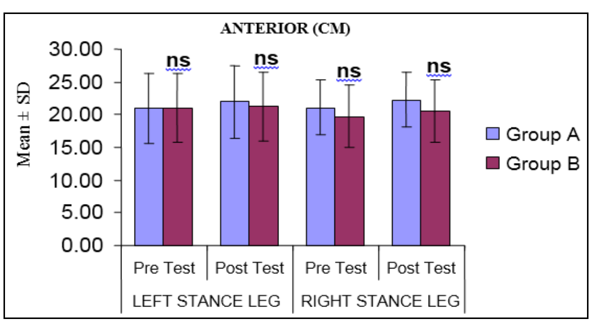
Table 3: Pre and post functional mobility parameters (Mean ± SD, n=15) of two groups and both Outcome Measures: Functional Mobility

Parameters	Group	Left stance leg			Right stance leg			p value (Left vs. Right)	
		Pre test	Post test	p value	Pre test	Post test	p value	Pre test	Post test
Anterior (cm)	Group A	21.03 ± 5.36	21.95 ± 5.57	1.000	21.13 ± 4.23	22.28 ± 4.12	0.998	1.000	1.000
	Group B	20.99 ± 5.30	21.31 ± 5.26	1.000	19.75 ± 4.79	20.55 ± 4.84	1.000	0.997	1.000
	p value	1.000	1.000	-	0.995	0.979	-	-	-
Anteromedial (cm)	Group A	18.96 ± 6.68	19.89 ± 6.60	1.000	19.05 ± 5.30	19.84 ± 5.63	1.000	1.000	1.000
	Group B	20.61 ± 5.55	20.18 ± 5.08	1.000	18.88 ± 4.64	18.62 ± 4.89	1.000	0.990	0.995
	p value	0.992	1.000	-	1.000	0.999	-	-	-
Medial (cm)	Group A	18.29 ± 6.40	19.97 ± 6.68	0.991	16.88 ± 5.80	18.31 ± 6.66	0.997	0.997	0.991
	Group B	17.01 ± 4.73	17.47 ± 4.55	1.000	17.26 ± 4.28	17.33 ± 3.97	1.000	1.000	1.000
	p value	0.998	0.917	-	1.000	1.000	-	-	-
Posteromedial (cm)	Group A	14.85 ± 8.08	15.93 ± 7.63	1.000	13.29 ± 6.48	15.60 ± 6.38	0.972	0.997	1.000
	Group B	15.65 ± 5.33	15.33 ± 5.64	1.000	15.77 ± 4.42	16.63 ± 5.03	1.000	1.000	0.999
	p value	1.000	1.000	-	0.958	1.000	-	-	-
Posterior (cm)	Group A	13.46 ± 7.18	14.13 ± 6.73	1.000	16.23 ± 5.02	17.17 ± 4.95	0.999	0.735	0.632
	Group B	17.75 ± 2.01	17.57 ± 2.88	1.000	16.68 ± 2.64	17.07 ± 2.91	1.000	0.998	1.000
	p value	0.198	0.477	-	1.000	1.000	-	-	-
Posterolateral (cm)	Group A	13.77 ± 7.38	14.90 ± 7.06	1.000	13.91 ± 6.36	15.67 ± 5.87	0.992	1.000	1.000
	Group B	18.59 ± 4.51	19.03 ± 4.67	1.000	14.68 ± 4.38	15.99 ± 5.63	0.999	0.597	0.843
	p value	0.322	0.529	-	1.000	1.000	-	-	-
Lateral (cm)	Group A	14.49 ± 4.58	15.20 ± 4.21	1.000	17.80 ± 4.49	18.72 ± 4.64	1.000	0.623	0.545
	Group B	18.65 ± 5.02	18.81 ± 5.10	1.000	16.59 ± 5.98	16.97 ± 5.97	1.000	0.951	0.973
	p value	0.326	0.510	-	0.998	0.980	-	-	-
Anterolateral (cm)	Group A	16.83 ± 6.18	17.79 ± 5.64	1.000	17.01 ± 4.36	18.32 ± 4.67	0.998	1.000	1.000
	Group B	18.93 ± 4.73	20.75 ± 5.32	0.987	17.87 ± 6.79	18.13 ± 6.79	1.000	1.000	0.907
	p value	0.970	0.837	-	1.000	1.000	-	-	-
Composite score (%)	Group A	47.82 ± 16.64	50.75 ± 15.76	0.999	49.20 ± 13.38	53.09 ± 13.65	0.994	1.000	1.000
	Group B	52.38 ± 11.43	53.20 ± 11.80	1.000	48.61 ± 12.40	49.93 ± 12.57	1.000	0.995	0.998
	p value	0.984	1.000	-	1.000	0.998	-	-	-

The pre and post functional mobility i.e. maximum reach distances of eight directions (anterior, anteromedial, medial, posteromedial, posterior, posterolateral, lateral and anterolateral) of both groups (Group A: PNF exercise and Group B: Mutisensory approach exercise) and limbs (left and right) and their composite scores were compared by three factor mixed model ANOVA and summarized in Table 8.2 and also shown graphically in Fig 4 to 12, respectively. The descriptions of each direction are summarized below:

1. Anteri

Table 1 and Gig 4 both showed that the mean anterior maximum reach distance in both groups and both legs (limbs) increased (improved) after the exercise (post exercise) as compared to no exercise (pre exercise) and the increase (improvement) was evident higher in Group A than Group B

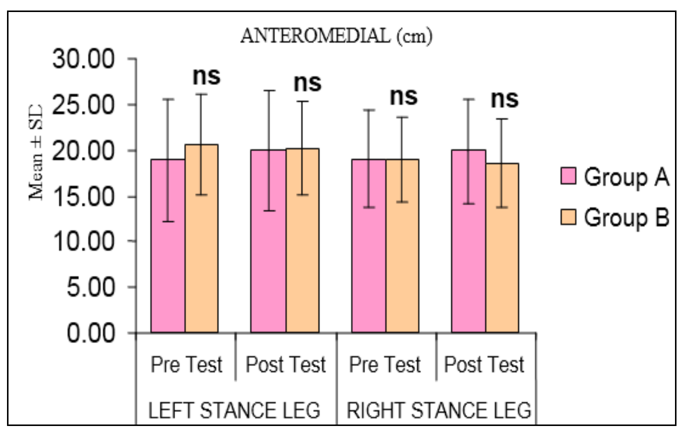


^{ns}p>0.05- as compared to Group A

Fig 4: Pre and post mean anterior maximum reach distance of two groups and two limbs.

2. Anteromedial

Table 8.1 and Fig 5 both showed that the mean anteromedial maximum reach distance in both legs of Group A increased (improved) at post while in both legs of Group B it decreased slightly at post as compared to pre.

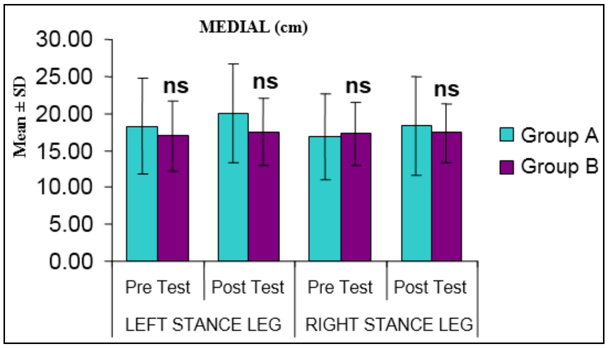


^{ns}p>0.05- as compared to Group A

Fig 5: Pre and post mean anteromedial maximum reach distance of two groups and two limbs.

3. Medial

Table 8.1 and Fig 6 both showed that the mean medial maximum reach distance in both groups and limbs increased (improved) at post and the improvement was evident higher in Group A than Group B.

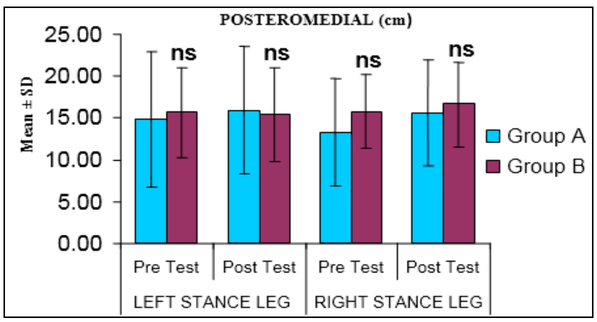


^{s}p>0.05- as compared to Group A

Fig 6: Pre and post mean medial maximum reach distance of two groups a

3. Posteromedial

Table 8.1 and Fig 7 both showed that the mean posteromedial maximum reach distance in both groups and limbs (except left limb in Group B) increased (improved) at post and the improvement was evident higher in Group A than Group B.

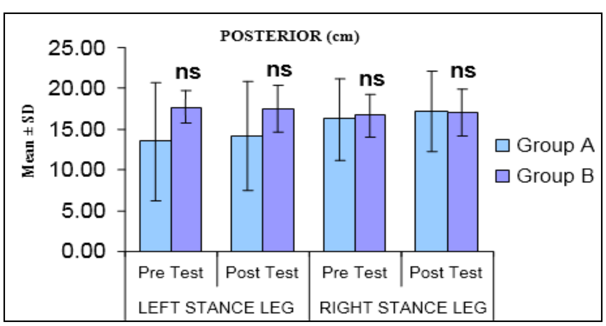


^{ns}p>0.05- as compared to Group A

Fig 7: Pre and post mean posteromedial maximum reach distance of two groups and two limbs.

4. Posterior

Table 8.1 and Fig 8 both showed that the mean posterior maximum reach distance in both groups and limbs (except left limb in Group B) increased (improved) at post and the improvement was evident higher in Group A than Group B.

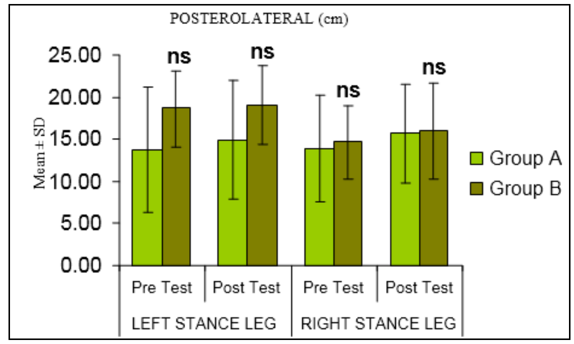


^{ns}p>0.05- as compared to Group A

Fig 8: Pre and post mean posterior maximum reach distance of two groups and two li

5. Posterolateral

Table 8.1 and Fig 9 both showed that the mean posterolateral maximum reach distance in both groups and limbs increased (improved) at post and the improvement was evident higher in Group A than Group B and higher in right than left..

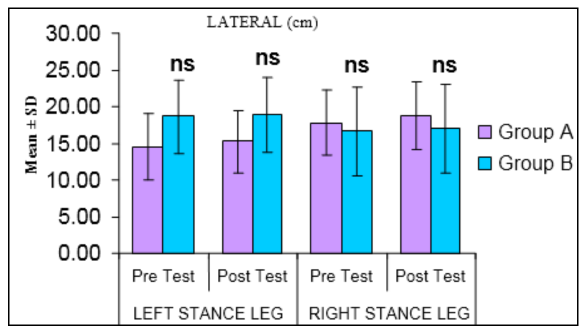


^{ns}p>0.05- as compared to Group A

Fig 9: Pre and post mean posterolateral maximum reach distance of two groups and two limbs.

6. Lateral

Table 8.1 and Fig 10 both showed that the mean lateral maximum reach distance in both groups and limbs increased (improved) at post and the improvement was evident higher in Group A than Group B and higher in right than left.

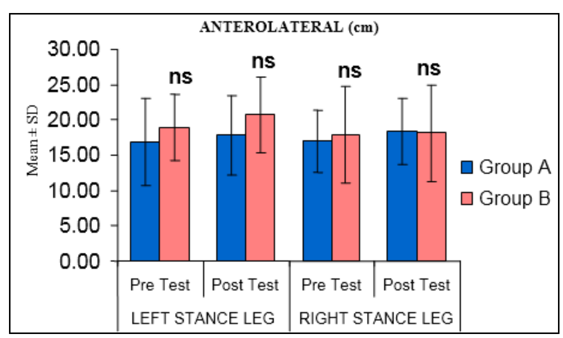


^{ns}p>0.05- as compared to Group A

Fig 10: Pre and post mean lateral maximum reach distance of two groups and two limb

7. Anterolateral

Table 8.1 and Fig 11 both showed that the mean anterolateral maximum reach distance in both groups and limbs increased (improved) at post and the improvement was evident higher in right limb of Group A than Group B while left limb in Group B than Group A.

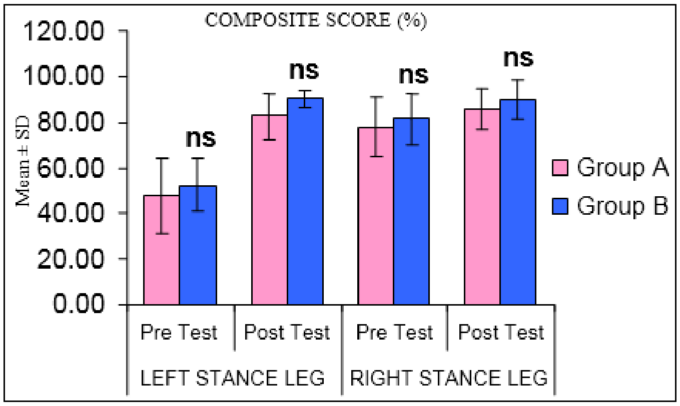


^{ns}p>0.05- as compared to Group A

Fig 11: Pre and post mean anterolateral maximum reach distance of two groups and two limbs.

8. Composite score

Table 8.1 and Fig 12 both showed that the mean composite scores of all eight reach directions in both groups and limbs increased (improved) at post and the improvement was evident higher in Group A than Group B and left limb than right limb.



$^{ns}p>0.05$- as compared to Group A

Fig 12: Pre and post mean composite scores of two groups and two limbs

Discussion

The aim of this study was to compare the effect of two different interventions (PNF, Multisensory Approach) on dynamic balance and functional mobility on elderly populations. The readings of the outcome measures dynamic balance were measured with SEBT. Prior to training, both the Group A and Group B demonstrated similar performance on the SEBT in the measured variables. Following the interventions, the SEBT composite score of all eight reach directions in both groups and limbs increased (improved) at post and the improvement was evident higher in Group A than Group B and right limb than left limb.

PNF exercises are very similar to the actions and movements found in various sports. They therefore appear to be more suitable for performance enhancement than conventional weight training programmes [3, 1]. The proprioceptive neuromuscular facilitation also uses the resistance, but in order to assist in muscle contraction, maximize motor control and assist movement awareness, which leads to an increase in muscle response to the cortex. These stimulated to the cortical region will depend on the intensity of resistance, ie, the greater the resistance, the greater the stimulus, noting that this resistance has to be enough movement occurs smoothly and coordinated, causing no pain or fatigue to patients [4, 5].

PNF technique which is presented as an interesting choice, since according to Lee and Kerrigan, exercise programs with objective to enhance balance on elderly should involve coordination and proprioception activities and not only strengthen exercises [13]. According to literatures by Fabrio Maron Alfieri, Marcelo Riber exercises performed with balls on unstable surfaces, with different head positions and exercises combined with visual suppression, should be used to improve the postural control on the senior populations because they involve visual, somatosensory and musculoskeletal systems, increasing receptors' sensitivity and providing better conditions for balance control [9].

According to Lucinda E. Bouillonstated that SEBT is a dynamic single- limb balance test that has been used in atheletic and recreational active college age population. In his study he found that dynamic balance decreases with age [14]. The SEBT requires lower extremity coordination, balance, flexibility, and strength [15]. According to Garrett F. Coughlan, in his study comparison between performance of selected directions of SEBT and Y – TEST, an individual is required to move from a starting position of 2-legged stance to single-legged stance while maximally reaching along set multidirectional lines with the opposite leg and touching down lightly on the tape with the distal end of the reach foot, without compromising equilibrium. These reaching tasks are designed to challenge postural control, strength, range of motion, and proprioceptive abilities [16]. The SEBT can assess improvements in dynamic postural control after Exercise interventions [30].

The difference in the improvement in functional mobility between the groups may be relatively to the fact that exercise programs involving movements which follow diagonal movements patterns, parallel to muscular topography and similar to that used on day- life activities can prepare subjects to respond in a more properly way to balance disturbances [13]. lower torque and power production on elderly fallers is associated with an increase coactivation around knee and ankle. Coactivation is defined as the simultaneous muscle co contraction around a joint, had also being pointed as responsible to reduced walking speed and increased fall risk of elderly [13]. It was also suggested that a higher balance between the agonistic and antagonistic muscles activation is achieved after PNF exercises reducing coactivation. However the effect of PNF program on fall risk in older people are still unknown [13]. PNF patterns have a spiral, diagonal direction and are in line with the topographical arrangement of the muscles facilitating the activation of bi-articular muscles [13].

Improvement in the Group A appeared to bethe result of PNF technique which is presented as an interesting choice, since according to Lee and Kerrigan, exercise programs with objective to enhance balance on elderly should involve coordination and proprioception activities and not only strengthen exercises [13]. According to Jesper, in some conditions, strength improvement can be attributed to supra-spinal neural adaptations and not to peripheral paths, as normally seen [13]. Hence, it is also suitable to affirm that PNF training program used in this study induces a response more related to an appropriate reaction to balance perturbation than to strength level improvement [13]. Prior research indicates that isolated strength measures may not have an effect on the SEBT score [15]. There is low to moderate correlation between SEBT performances and lower extremity strength. Therefore, other factors, such as muscle activation and proprioception, may have a stronger relative relationship to the SEBT performance than non- weight -bearing strength testing [15].

The study of Fabio Macron Alfieri, states that exercises performed with balls on unstable surfaces, with different head positions and exercises combined with visual suppression, should be used to improve the postural control on the senior populations because they involve visual, somatosensory and musculoskeletal systems, increasing receptors' sensitivity and providing better conditions for balance control [9].

Conclusion
This study concluded that both groups had an improvement in the dynamic mobility as measured in SEBT scores. But only the PNF technique obtained statistically significant gains after four weeks of intervention. However, when comparing both the interventions, there was no statistically significant difference.

References

1. PoojaChauhan V, Chandrashekar PA. Study on Morbidity Pattern among the Geriatric People of Venkatachalem Village, Nellore District A.P., Nrims Journal of Health Sciences, 2013, 1(2).
2. Granacher U1, Gollhofer A, Hortobágyi T, Kressig RW, Muehlbauer T. The Importance of Trunk Muscle Strength for Balance, Functional Performance, and Fall Prevention in seniors: A Systematic Review**,** Sports Med. 2013; 43(7):627-41. Doi: 10.1007/S40279-013-0041-1.
3. JuditTakacs, Mark G. Carpenter. Jayne Garland, Micheal A. Hunt, the Role of Neuromuscular Changes in Aging and Knee Osrteoarthritis in Dynamic Postural Control. 2013; 4(2):84-99.
4. ClarrissaVarros DE Oliveire PT, *et al.*, Jounal of Rehabilitation Research and Development, Balance Control in Hemiparetic Stroke Patients: Main Tools for Evaluation, 2008, 45(8).
5. Phillip A. Gribble Phd, Jay Hertel, Phd *et al*., Using The Star Excursion Balance Test To Assess Dynamic Postural- Control Deficits And Outcomes In Lower Extremity Injury: A Literature And Systematic Review, 2008, 45(8).
6. Marjorie H Woollacott, Pei-Fang Tang. Balance Control during Walking in the Older Adult: Research and Its Implications, Phys Ther. 1997; 77:646-660.
7. Laurence Z, Rubenstein Md, Mph Karen R, Josephson. Falls And Their Prevention in E; Lderly People: What Does the Evidence show? Mph Med Clin N Am. 2006; 90:807-824
8. Prevquedas Brazil, Kelem DE Negreiros, *et al.* Effectiveness Of A Multifactorial Falls Prevention Program In Community – Dwelling Older People When Compared To Ususal Care:Study Protocol For A Randomised Controlled Trial Bmc Geriatics. 2013; 13:27
9. Fabrio Maron Alfieri, Marcelo Riberto, *et al.*, Functional Mobility And Balance In Community- Dwelling Elderly Submitted To Multisensory Versus Strength Exercises, Dove Press Journal, Clinical Interevntion In Aging, 2010, 5.
10. Sarah D. Berry, Md, Mph, Falls I. Epidemiology, Pathophysiology, And Relationship To Fracture, nstitute Gor Aging Research, 2008.
11. Phillip A Gribble, Jay Hertel. Measurement in Physical Education and Exercise Science, Considerations for Normalizing Measures of the Star Excursion Balance Test, 7(2):89-100.
12. Marcelo Pinto Pereira, Mauro Gonc. Alves, Proprioceptive Neuromuscular Facilitation Improves Balance And Knee Extensors Strength Of Older Fallers, Isrn Rehabilitation, 2012, Article Id 402612, Doi:10.5402/2012/402612
13. Lucinda E. Bouillon, Pt, Phd *et al*., Dynamic Balance Differences As Measured By The Star Excursion Balance Test Between Adult – Aged And Middle – Aged Women Sp[Orts Health. 2011; 3(5):466-469.
14. Alyson Filipa, Pt Robyn Pyrnes, Pt Mark V, Paterno Pt, Gregory D, Myer *et al.*, Neuromuscular Training Improves Performance On The Star Eexcursion Balance Test In Young Female Atheletes, J Ortho Sports Phys Ther. 2010; 40(9):551-558.
15. Nick Kofotolis and ElefttheriosKellis. Effects of Two 4-Week Proprioceptive Neuromuscular Facilitation Programs on Muscle Endurance, Flexibility, And Functional Performance in Women with Chronic Low Back Pain, PhysTher. 2006; 86: 1001- 1012
16. Garrett F. CoughanPhd, BscPhysio, Karl Fullam, BscPhysio, *et al*., A Comparision Between Performasnce On Selected Directions Of The Star Excursion Balance Test And The Y Balance Test, J Athl Train.2012 August; 47(4): 366-371.
17. Marcelo Pinto Pereira, Ms, Pt, Proprioceptive Neuromuscular Facilitation Does Not Increase Blood Pressure Of Healthy Elderly WomenDoi:104109/09593985.2011.609582
18. Marjorie. H Woollacott, Int'l. J. Aging And Human Development, Vol. 23(2), 1986
19. Age-Related Changes Of Human Balance During Quiet Stance D. Abrahamová, F. Hlavacka, Aging And Postural Control: Changes In Sensory Organization And Muscular Coordination, Institute Of Normal And Pathological Physiology, Slovak Academy Of Sciences, Bratislava, Slovakia Physiol. Res. 2008; 57:957-964.
20. Yves J Gschwind, Reto W Kressig, Andre Lacroix, Thomas Muehlbauer, Barbara Pfenninger, Gschwind, *et al*. A Best Practice Fall Prevention Exercise Program To Improve Balance, Strength / Power, And Psychosocial Health In Older Adults: Study Protocol For A Randomized Controlled Trial, Bmc Geriatrics. 2013; 13:105.