

# Comparison between One Arm and Two Arm Functional Reach Test for Assessment in Patients with Balance Impairment

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**Abstract:** A comparative prospective study was conducted between one arm and two arm functional reach test to determine which of the two is more efficient for assessment in balance impaired adults. Thirty subjects of age group 40-60 years with balance impairment (TUG > 25secs) were included in the study. On comparison of reach values of both one arm and two arm functional reach test p value and t value were 0.0047 and 3.061 respectively ; indicating it very significant. The study concluded that both 1AFRT and 2AFRT can be used for assessing balance impaired adults but however, 2AFRT is more challenging than one arm functional reach test for assessing balance in balance impaired adults.

**Keywords:** Balance impaired, Functional Reach Test, Assessment.

## 1. Introduction

Balance is a condition in which all the forces acting on the body, such that the Centre of Mass [COM] is within the stability limits, the boundaries of the Base of Support [BOS] [1]. Functional task require different types of balance control including: (a) static balance control to maintain a stable antigravity position while at rest, such as when standing and sitting. (b) dynamic control to stabilize the body when the support surface is moving or when the body is moving on a stable surface, such as sit to stand transfers or walking; and (c) automatic postural reactions to maintain balance in response to unexpected external perturbations, such as standing on a bus that suddenly accelerates forward [2]. Balance control requires the interaction of the nervous and musculoskeletal systems and contextual effects. Nervous system contribution in balance The musculoskeletal contribution includes postural alignment, flexibility, joint integrity, muscle performance and sensation. Contextual effects that interact with the two systems are the environment whether it is closed or open, the support systems, amount of lighting, effects of gravity and inertial

forces on the body. The nervous system provides the sensory processing, sensorimotor integration, and motor strategies for planning programming and executing balance responses. [3]

Statistics for balance system disorders can vary by type of disorder and how long it lasts. According to the NIDCD, 4% of adults—8 million Americans—reported a chronic problem with balance, and an additional 1.1% (2.4 million) reported a chronic problem with dizziness (NIDCD, 2005). It is estimated that approximately 40% of the population in the United States will experience some form of dizziness or balance difficulty over the course of a lifetime (National Institute on Deafness and Other Communication Disorders [NIDCD], 2014). The true incidence and prevalence of balance system disorders in adults and children are unknown. This may be due, in part, to the wide range of symptoms attributable to balance disorders, the underlying cause, the length or frequency of the disorder, and the varied diagnostic techniques used for detection. A 2008 Balance and Dizziness Supplement to the U.S. National Health Interview Survey expressed that symptom reports of dizziness and imbalance in adults increased with age. Additional population-based studies found that 30% of adults aged 65 years and older experience some form of dizziness, and 24% of adults aged 72 years and older reported symptoms of dizziness lasting at least 1 month [4].

Impaired balance can be caused by injury or disease to any structures involved in the three stages of information processing – sensory input, sensorimotor integration and motor output generation. In sensory input impairment; proprioceptive deficits have been implicated as contributing to balance impairments following lower extremity and trunk injuries or pathologies, decreased joint position sense, degenerative joint disease. In sensorimotor integration impairments; damage to the basal ganglion, cerebellum or supplementary motor area impair processing of incoming sensory information, results in difficulty

adapting sensory information in response to environmental changes in disruption of anticipatory and reactive postural adjustments. In individuals with neurological conditions, failure to generate adequate muscle forces due to abnormal tone or impaired coordination of motor strategies may limit the person's ability to recruit muscles required for balance [5]. Balance impairment negatively affects function, leading to disability and when severe, results in falls [1].

Activities such as bending or reaching up or to the side require shifting the Centre of Gravity (COG) within the base of support (BOS). Once the COG moves outside the BOS, the Limits of Stability (LOS) for the currently executed balance strategy are exceeded. An automatic movement strategy is executed to maintain balance by either realigning the COG within the BOS or by evoking a step strategy and establishing a new BOS. If the appropriate movement strategy is not executed, the individual may stumble or fall in an attempt to regain balance [6]. Studies of fall incidence in persons with PD suggest that over the course of the disease, the majority of individuals with PD will develop problems with postural instability and falls. In addition, there are consistent reports of postural instability being a strong determinant of perceived disability in PD and that postural instability and falls lead to an increase in morbidity and mortality [7]. Knee osteoarthritis (OA) is one of the most prevalent musculoskeletal complaints worldwide, affecting 30–40% of the population by the age of 65 yr. It is a major cause of impairment and disability among the elderly, and poses a significant economic burden on the community. Individuals with knee OA suffer progressive loss of function, displaying increasing dependency in walking, stair climbing and other lower extremity tasks. Balance is an integral component of these and many other activities of daily living. Understanding the impact of knee OA on balance may allow possible mechanisms of disability in this patient population to be elucidated, and may permit more effective management of patients with the disease. Balance is a complex function involving numerous neuromuscular processes [8].

The numerous clinical tests that have been used to assess balance focus on varying aspects of the balance construct. Each clinical test may provide a unique contribution to the complete description of an individual's balance capabilities. For example, the Functional Reach Test (FRT) estimates fall risk by measuring the distance an individual can reach forward with an outstretched arm when the feet are planted on the floor. The Multi-Directional Reach Test (MDRT) is a modification of the FRT and involves the individual reaching forward,

backward, right, and left. The FRT and MDRT are measures of balance while standing in place [9]. Standardized test for balance are available that examine functional performance which includes The Berg Balance Scale, Timed Up and Go (TUG), Tinetti Performance Oriented Mobility Assessment (POMA), Functional Reach (FR), Timed Walking Test, Multidirectional Reach Test (MRDT) [10]. The Functional Reach Test (FR) was developed by Duncan and co-workers to provide a quick screen of balance problems [6]. The Functional Reach Test (FRT) is an inexpensive and easy to use tool to assess LOS in the forward direction [11]. A new measure of balance, functional reach, has been recently developed. Functional reach is the maximal distance one can reach forward beyond arm's length while maintaining a fixed base of support in the standing position [10]. For the Two arm functional reach test the starting and reaching position are measured in similar manner. The two arms are extended forward to 90 degree of shoulder flexion with the hands clasped and the index fingers extended together [1]. The "Get-up and Go" Test was designed to measure mobility in elderly people and has been advocated as a useful tool for quantifying locomotor performance in people with PD. This test requires people to stand up from a chair, walk 3 m, turn around, walk back to the chair, and sit down again. To increase the reliability of the measurements while ensuring that the test continued to be quick and easy to administer, Podsiadlo and Richardson modified the "Get-up and Go" Test to incorporate a timed component [12]. The Timed Up & Go Test (TUG) is a test of balance that is commonly used to examine functional mobility in community-dwelling, frail older adults. Older adults who are able to complete the task in less than 20 seconds have been shown to be independent in transfer tasks involved in activities of daily living, have high scores on the Berg Balance Scale, and walk at gait speeds that should be sufficient for community mobility (0.5 m/s). In contrast, older adults requiring 30 seconds or longer to complete the task tend to be more dependent in activities of daily living, require assistive devices for ambulation, and score lower on the Berg Balance Scale. Although the TUG has been shown to be useful for predicting level of functional mobility, its validity for identifying community-dwelling older adults who are at risk for falls is unknown. Functional mobility is a term used to reflect the balance and gait manoeuvres used in everyday life [13].

## 2. Methods

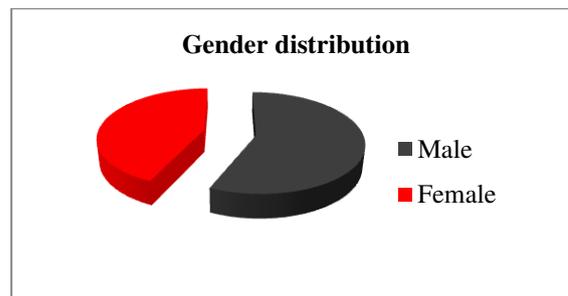
### 2.1. Study Design

A comparative prospective study was carried out on thirty participants from Dr. APJ Abdul Kalam College of Physiotherapy. All participants were screened for the inclusion and exclusion criteria. The inclusion criteria were: age group of 40-60 years, able to follow simple verbal commands, TUG score >25 sec, able to walk independently without using walking aids and exclusion criteria were: visual hearing impairments, any deformity, pain or contractures, any medical condition not allowing the person to stand.

### 2.2. Procedure

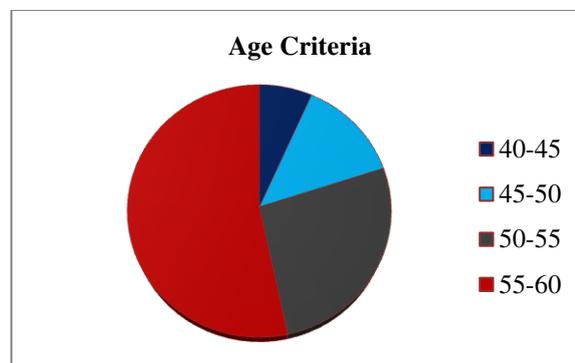
Ethical approval was obtained from the Institutional Ethical Committee. The participants were briefed about the nature of study, the duration of the test in the language best understood by the patient. They were encouraged to clarify queries regarding the study, if any. An informed written consent form was obtained from the participants and then the demographic data was collected, the participants were oriented to wear comfortable clothing for proper circulation and for not hampering the movement. The individuals performed the Timed UP and GO test. The participants full filling the inclusion criteria of the Timed UP and GO test were asked to perform the one arm Functional Reach Test in standing for three trials bare foot. The arm extended forward to 90 degree of shoulder flexion, elbow extended wrist in neutral position and with proper base of support, the participant is then asked to reach the maximal distance one can reach forward beyond arm's length while maintaining a fixed base of support in standing. The best of the reading was then noted. The next day, same participant was asked to perform Two Arm Functional Reach Test for three trials bare foot in standing as well, the two arms extended forward to 90 degree of shoulder flexion, elbow extended and with the hands clasped, index fingers extended together, and then asked to reach forward beyond arm's length while maintaining a fixed base of support in standing. The best of the reading were then noted. During the whole procedure one therapist is right behind the participant to prevent any fall while performing the Functional Reach Test (FRT).

## 3. Data analysis and Result



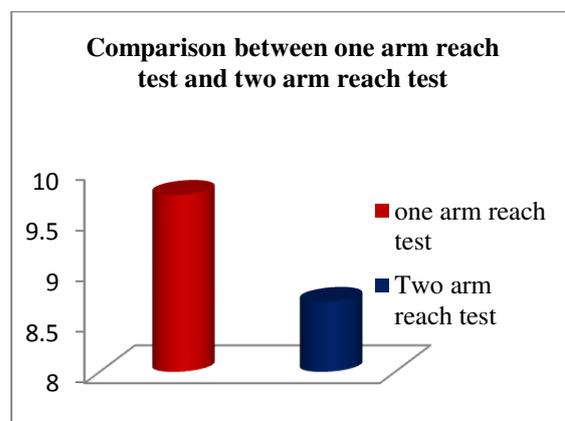
Graph1. Represents the total no. of male and female participants

Result: The study was carried out in 30 balance impaired patients out of which 17 were male and 13 were female patients



Graph2. Represents the no. of patients in each age group

Result: There were total of thirty patients out of which 02 belonged to 40-45 age group, 04 in 45-50 age group, 08 in 50-55 age group and 16 in 55-60 age group.



Graph3. Represents comparison of one arm and two arm reach test

Result: The mean and standard deviation for one arm functional reach test was 9.74 and 1.908 respectively. For two arm functional reach test the

mean and standard deviation was 8.69 and 1.545 respectively; in which p value was 0.0047 and t value was 3.061; indicating very significant.

#### 4. Discussion

The study was carried out to compare the one arm and two arm functional reach test, which showed the t value as 3.061 and p value as 0.0047; indicating very significant thus proving that two arm functional reach test is more challenging than one arm functional reach test. As two arm functional reach test limits the trunk rotation and increases the difficulty of the test, it can be used for assessment in balance impaired patients. This supports the study carried out by Mamin P. et al showing the two arm functional reach test more efficient for balance impaired children.

Also the study carried out by Mamin P. et al compared the reach values by different method of toe to finger and finger to finger, in one arm and two arm functional reach test concluding that the two arm functional reach test is more challenging for children with balance impairment [1]

Lynch S., Leahy P. et al showed modified FRT reliable for measuring sitting balance in thirty nonstanding males with spinal cord injuries, as the interclass coefficient obtained varied from .85 to .94, which proves that Functional Reach Test (FRT) could be modified to provide reliable measurements of sitting balance in SCI individuals [14]

Another study comparing the Berg Balance Scale and Functional Reach; the best clinical tool for individual's post-acute stroke by Patricia S. S., Judith A. H. et al took seventy-five subjects who had suffered a stroke and were divided into four groups based on the Duncan classification for stroke severity. The performance on the Berg Balance Scale was closely associated with performance on the Functional Reach, and the Spearman rank correlation coefficient was excellent among the entire sample ( $r_s=0.78$ ). Electing the use of shorter Functional Reach as a measure of balance where efficient in which use of time was the primary goal [15]

Timed UP and GO alone or combination of Functional Reach Test and Timed UP & GO can be used as a simple measure of balance comparable to Berg Balance was stated in the study carried out by Scott B, Goodman B., et al, in which they compared Time UP and Go and Functional reach test FRT with Berg Balance Scale for concurrent validity in 20 broad adult population ranging 38

to 86 years of age showing significant correlation between Berg Balance Scale and Time UP and GO and when Time UP and GO & Functional Reach Test are paired [16]

#### 5. Conclusion

The study concluded that both one arm functional reach test and two arm functional reach test can be used for assessing balance impaired adults but however, two arm functional reach test is more challenging than one arm functional reach test for assessing balance impaired adults.

#### 6. References

- [1] Mamin, P; Sharma, S; Richa; A Comparative study Between one arm and two arm Functional reach test in children with balance impairment. Indian journal of Physiotherapy and Occupational Therapy. 2015 march; 9(1).
- [2] Kisner, C; Colby, LA; Therapeutic Exercise, Foundations and Techniques Chp.8 .6<sup>th</sup> Ed. p. 263
- [3] Horak, F; Postural Orientation and equilibrium: What do we need to know about neural control of balance to prevent falls? Age aging.2006 September,35(2).
- [4] <http://www.asha.org/PRPSSpecific> Topic.aspx?folderid=8589942134&section=Treatmentbalance.[Online]
- [5] Shumway, Woollacott, MH; Motor Control: theory and Practical Applications.Ed.2.Philadelphia:Lippincott, Williams & Wilkins.2001.
- [6] Newton, RA; Validity of the Multi-Directional reach test: A Practical Measure for limits of stability in older adults. Journal of Gerontology. Medical Sciences.2001, Volume.56A, (no.4)
- [7] Dibble, LE; Papa, E; The effects of exercise on balance in person with Parkinsons Disease: A systematic Review across the Disability Spectrum. Journal of Neurologic Physical Therapy .2009 March, 33(1):p.14-26
- [8] Hinman, RS; Bennell, KL; Metcalf, BR; Crossley, KM; Balance impairments in individuals with symptomatic knee osteoarthritis: A comparison with matched controls using clinical test.Rheumatology.2002, 41(12):p.1388-1394
- [9] Holbein-Jenny, MA; Billek-Sawhney, B; Beckman, E; Smith, T; Balance in personal care home residence : A comparison of the Berg Balance Scale, The Multi- Directional Reach Test

and the Activities- Specific Balance Confidence Scale. *Journal of Geriatric Physical Therapy*, Vol.28 (2), p.5.

[10] O'Sullivan, SB; Schmitz, TJ; *Physical Rehabilitation*. 5<sup>th</sup> Ed. Jaypee Brothers Chap.8, P. 254, 257.

[11] Prescott, B; Duncan, PW; *Functional Reach Predictive Validity in a Sample of Elderly Male Veterans*. *Gerontology Journal*. 1992, 47:p.93-98

[12] Morris,S; Morris, ME; Jansek, R; *Reliability of Measurements Obtained with the Timed Up & Go Test in People with Parkinsons Disease*. *Physical Therapy*.2001.February,81(2)

[13] Brauer, S; Woollacott, M; Shumway, CA; *Predicting the Probability of falls in community – dwelling older adults using the timed Up & Go test*. *Physical Therapy*. 2000 September; 8(9)

[14] Lynch, S; Barker, S; Leahy, P; *Reliability of Measurements Obtained With a Modified Functional Reach Test In Subjects With Spinal Cord Injury*, *Physical Therapy*.1998 February,78(2).

[15] Patricia, S Smith; Judith, A Hembree; Thompson, Mary E; *Berg Balance Scale and Functional Reach: determining the best clinical tool for individuals post-acute stroke* *Clinical Rehabilitation* November 2004 vol. 18 no. 7 811-818

[16] Bennie, S; Goodman, B; Bruner, K; Dizon, A; Fritz, H; Petterson, S; *Measurements of Balance: Comparison of the Timed Up & Go Test and Functional Reach Test with the Berg Balance Scale*. *Journal of Physical Therapy Science*.2003, 15(2).