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Backward Tandem Walk Test with Fear of Fall, Balance and Functional Mobility in Parkinsonism: A Correlational Study

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Abstract

Aim: The study was done to assess the backward disequilibrium as a tool. There is no component assessing for backward disequilibrium in frequent assessing the balance test. So, the present study is to find out the association between BTWT and other balance and functional mobility tools.

Introduction: Distinguishing between a clinically significant change and change due to measurement error can be difficult. Backward walking is an intervention that may be valuable for enhancing balance and self-efficacy to improve mobility function. The postural and motor control requirements of Backward Walking Training (BWT) may provide benefits to improve balance and walking speed in this population. The study was done to determine the association between Backward disequilibrium, fear of fall, balance and functional mobility in Parkinsonism.

Methods: This was a retrospective study which was conducted on a total 50 Parkinsonism patients (both males and females) were taken. Subjects were selected based on the following inclusion and exclusion criteria. Subjects were included based on the following criteria. a)All subjects between the age of 65-85 years b)Patient who were able to understand and follow verbal commands c) Walk independently without assistive device for at least 6 meters d)The MMSE score more than or equal to 24/30.Subjects who are Unstable or limiting cardiac disease (e.g. History of myocardial infarction, coronary artery bypass or other cardiac surgery) within the previous 1 year, Any Respiratory conditions requiring oxygen supplementation or frequent use of inhaler , History of any of the following disease (Severely disabling arthritis, joint instability, back pain, abdominal surgery within the previous 1 year, lower limb joint replacements, documented dementia or significant clinical depression and diabetes) & Any Acute illness or injury on the day of assessment.After checking for eligibility criteria, Inform consent was obtained. To familiarize the subject appropriate instructions and a trial session of testing procedure was given. On the day of data collection, patients were verbally reoriented instructed again and testing procedure were carried out without shoes. The subjects were tested on the Lateral Step Test, FSST, Time Up Go, Backward Tandem Walk Test in randomized order with rest as per the patient required and three trial were taken

Result: The positive correlation were found of BTWT with mobility measures i.e. TUG and FSST (r=0.61, 0.57 and p= 0.01) and fairly correlating with balance measures i.e. rLST and lLST (r= 0.39, 0.31 and p=0.05) respectively

Conclusion: BTWT is being used to asses BD and has been found to be moderately correlating with mobility measures

Keywords: Balance, mobility, fear of fall, Parkinsonism.

Introduction

Parkinson's disease is a neurodegenerative disorder characterized by the loss of dopamine (DA) afferents innervating basal ganglia nuclei, including the striatum. The most abundant DA targets in the striatum are spiny projection neurons (SPNs). They form the “direct” and “indirect” basal ganglia pathways, whose balanced activity is proposed to control action selection[1]Postural instability in itself is not a life-threatening problem for persons with Parkinsonism. However, a growing body of evidence[2]points toward a significant increase in falls and fall related injuries in persons with Parkinsonism[3][4]and higher percentages of complications and increased mortality rates following hospitalization for an injury sustained during a fall. Persons with Parkinsonism are incapacitated by a number of motor impairments which compromise the ability to maintain upright stance. Among these are rigidity, bradykinesia, impaired postural reflexes[5]and dysfunctional vestibular, proprioceptive and visual systems[6]. Balance is an integral component to most activities of daily living. As a complex sensori-motor function balance control requires the integration of multiple systems such as vestibular, visual, and somesthetic information into the central nervous system (pyramidal& extrapyramidal systems) in order to maintain antigravity postures and to produce a suitable response to any balance perturbation.[6]Balance is defined as a complex process involving the

reception and integration of sensory inputs, and the planning and execution of movement, to achieve a goal requiring upright posture; it is the ability to control the center of gravity (COG) over the base of support in a given sensory environment[7].Deficits within the postural control system controlling stance balance that have been reported include changes in the temporal and spatial sequencing of muscles responding to loss of balance, increased dependence on visual cues for postural control, and a decreased ability to organize and select sensory information for postural control[8]. The apparent relationship between impaired balance and increased likelihood for falls among Parkinsonism patients.[9]. There are reports of a positive correlation between cortical and subcortical cerebral lesions, identified on magnetic resonance imaging, and Backward disequilibrium[10] degenerative and traumatic lesions of the basal ganglia could induce BD in parkinsonism patients[11]. BD is a postural disorder which is characterized by a posterior position of the centre of mass with respect to the base of support in the standing and sitting position predisposing subjects to backward falls[12].BD is associated with axial and limb rigidity. Backward disequilibrium could also be due to an imbalance between the ankle extensor muscles and the ankle flexor muscles, because of hypertonia of extensor muscles, which could be caused by a peripheral neurological lesion.[1]The pathophysiological mechanisms leading to BD behavior, however, have not yet been clearly identified[13][14].The geriatrician can also recognize BD, which is not uncommon in daily clinical practice, there are no tools to evaluate the severity. Only a few authors have examined this postural disorder in elderly subjects [15]. Parkinson patient suffering from BD have a high risk of falling backwards [16].Moreover, the diagnosis of BD is often made after a fall.Falls can cause trauma and have psychological and social consequences. Concerning trauma, hip fracture is the more seriousinjury[17] and there is a risk of posttraumatic subdural hematoma. These traumatic consequences are associated with a high risk of mortality [18]. The loss of autonomy is associated with a decrease in physical activity leading to reduced muscle mass and functional decline which predispose the patient to falls.Mobility tests are commonly used to assess function and frailty. Many of these tests are also used with younger adults as measures of physical fitness and general health. Kerstin et al. (1994) in their study assessed dynamic balance with a timed, backward tandem walk test[19]Arnold C.M. et al. (2002) in their study they has been found Backward Tandem Walk Test (BTWT) to be a sensitive test for detecting balance changes following an exercise intervention in PD[20]In present study BTWT is been used to assess the backward disequilibrium as a tool. There is no component assessing for BD in frequent assessing the balance test. So, purpose of the present study is to find out the association between BTWT and other balance and functional mobility tools in Parkinsonismpatient.

Methodology

Total 50 Parkinsonism patients (both males and females) were taken.Patients were selected through camps&Community center, gurugram. Sampling was done as per convenience.Subjects were selected based on the following inclusion and exclusion criteria.Subjects were included based on the following criteria.a)All subjects between the age of 65-85 years b)Patient who were able to understand and follow verbal commands c) Walk independently without assistive device for at least 6 meters d)The MMSE score more than or equal to 24/30.Subjects who are Unstable or limiting cardiac disease (e.g. History of myocardial infarction, coronary artery bypass or other cardiac surgery) within the previous 1 year, Any Respiratory conditions requiring oxygen supplementation or frequent use of inhaler , History of any of the following disease (Severely disabling arthritis, joint instability, back pain, abdominal surgery within the previous 1 year, lower limb joint replacements, documented dementia or significant clinical depression and diabetes)& Any Acute illness or injury on the day of assessment.

After checking for eligibility criteria, Inform consent was obtained. To familiarize the subject appropriate instructions and a trial session of testing procedure was given. On the day of data collection ,patients were verbally reoriented instructed again and testing procedure were carried out without shoes. The subjects were tested on the Lateral Step Test, FSST, Time Up Go, Backward Tandem Walk Test in randomized order with rest as per the patient required and three trial were taken.

Outcome measure

Best score of performance on all 4 functional test i.e. backward tandem walk test, lateral step test, Timed “up and go” test, Four square step test were recorded in seconds in data collection form (Appendix D). The screening was done on the day zero and data was collected for BTWT, TUG, FSST, lLST and rLST scores on the day one.

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Data analysis

The data was analyzed using SPSS-16 software and statistical test used was pearson's correlation coefficient test (r) to find the correlation of BTWT with TUG, FSST, rLST and lLST and significance was set at p=0.05 for data analysis in the present study and it is found that all the correlation in present study were positively significant.

Result

Total 48 subjects were included in the study and data was collected for BTWT, TUG, FSST, LST (r) and LST (l) recorded in seconds. The number of males and females was 33 and 15 respectively

Table/Figure: 1 Showing Baseline Characteristics of the Subjects

Parameters	Mean and SD
Age (years)	71.62± 5.39
Height (cm)	161.75± 8.12
Weight(kgs)	65.12± 12.56
BMI	24.91± 4.59
Hand dominance	Right (n=46) Left (n=2)
Leg dominance	Right (n= 39) Left (n= 9)

Table/Figure: 2: Showing mean and SD of correlation between the results of BTWT

TUG	FSST	rLST	lLST	BTWT
13.39 ± 3.30	16.36 ± 3.94	38.61 ± 5.92	38.25 ± 5.80	26.82 ± 7.26

Table/Figure: 3 showing correlation between the results of BTWT

Pearson correlation with BTWT	TUG	FSST	LST(r)	LST(l)
r	0.61	0.57	0.31	0.39
p	0.01	0.01	0.05	0.05

The positive correlation were found of BTWT with TUG.

The pearson's correlation coefficient (r=.61), and P value (0.01).(Table- 5.2, Graph-5.1)

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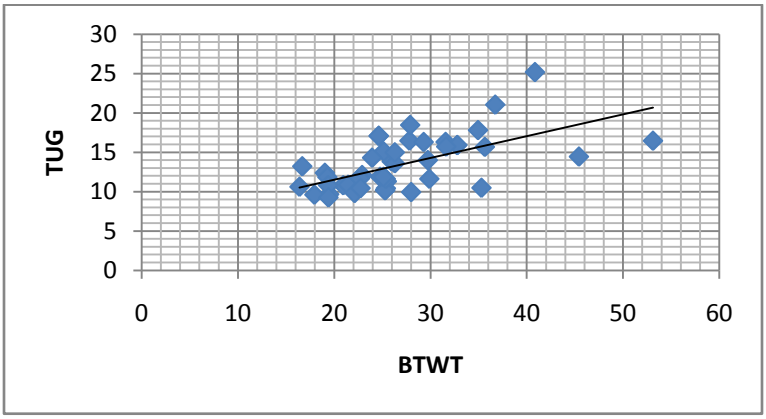
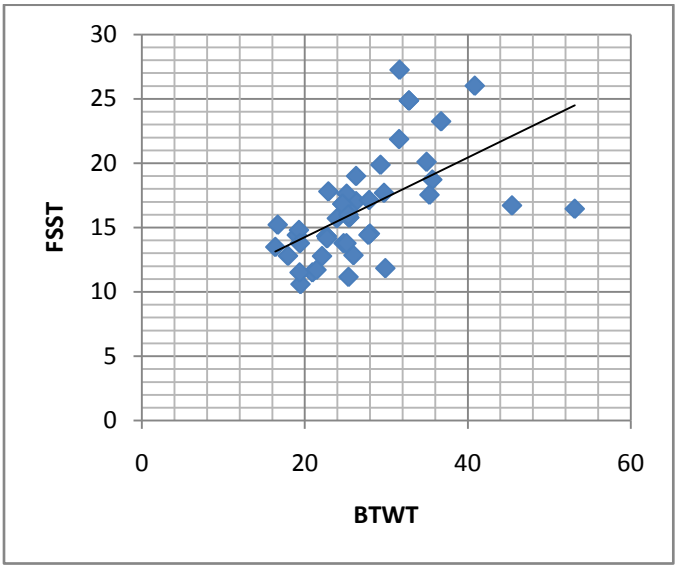
Graph 4: Showing the correlation between TUG and BTWT



The positive correlation is found of BTWT with FSST.

The pearson's correlation coefficient (r=.57), and P value (0.01).(Table- 5.2,Graph- 5.2)

Graph 5: Showing the correlation between FSST and BTWT



The positive correlation is found between BTWT and rLST.
The pearson's correlation coefficient (r=.31), and P value (0.05). (Table- 5.2, Graph-5.3)

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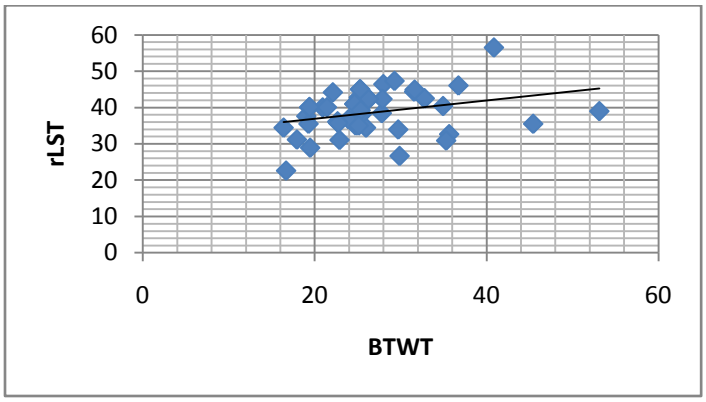
Graph 6: Showing the correlation between rLST and BTWT



The positive correlation was found of BTWT with lLST.

The pearson's correlation coefficient (r=.39), and P value (0.05). (Table- 5.2, Graph- 5.4)

Graph 7 : Showing the correlation between lLST and BTWT.

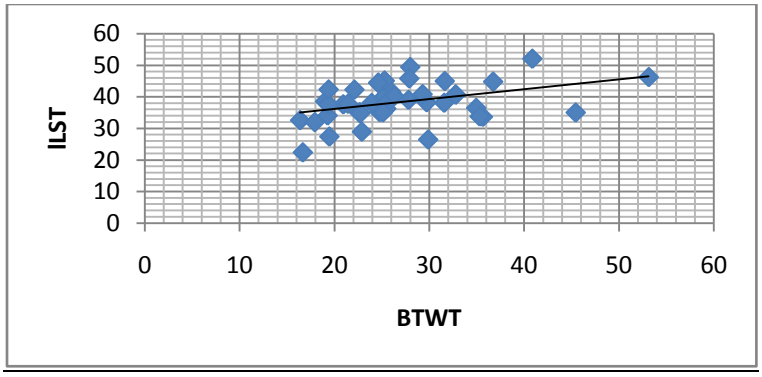


Table 5.4 Showing the correlation between TUG, FSST, rLST and lLST

		FSST	TUG	LST.RT	LST.LT
FSST	Pearson Correlation	1	.734**	.533**	.438**
	Sig. (2-tailed)		.000	.000	.002
TUG	Pearson Correlation	.734**	1	.486**	.467**
	Sig. (2-tailed)	.000		.000	.001
LST.RT	Pearson Correlation	.533**	.486**	1	.885**
	Sig. (2-tailed)	.000	.000		.000

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LST.LT	Pearson Correlation	.438**	.467**	.885**	1
	Sig. (2-tailed)	.002	.001	.000	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Discussion

In our study there was a positive correlation of timed Backward tandem walk test with fear of fall, balance and functional mobility in Parkinsonism patients.

BTWT involves patient's ability to maintain balance while moving backward in tandem fashion. It specifically assesses dynamic balance function while a subject is attempting to walk backward without getting direct visual feedback of the direction of progression. It further challenges the patient's ability by narrowing the base of support when Center Of Mass is shifting anteriorly which is not the natural way of his progression in activity of daily living. Since, BTWT is a novel task which imposes unique challenges to dynamic balance and mobility assessment. The researchers give the evidence of using BTWT for balance assessment and it also takes less time and is easily accessible to do without costing anything in clinical settings as it does not need any equipments.

BTWT has been used as a evaluating tool as well as a tool for training. There is different version of BTWT in various studies. There are various studies which used BTWT for assessing and as outcome measure in balance interventional studies. In present study BTWT was performance based on time taken by the subject to walk in backward direction for 20 consecutive steps.
C.M. Arnold et al (2002), found the test-retest reliability of BTWT in their pilot study of 20 older men and women (ICC = 0.92). They used this test for detecting balance changes following an exercise intervention in community dwelling older adults[19]
Miriam E. Nelson et al (1994), used BTWT as a assessment tool to check dynamic balance in this study subjects walk backward 20 foot with the toe of swing foot touches with the heel of stance foot.[23]
Patrick et al (2008) stated in their study that among the tests to assess balance and gait in elderly subjects, only the Minimum Motor Test includes items for a qualitative analysis of BD.[1]
Roberta A. Newton et al (2001), used multidirectional reach test to assess anterio-posterior and medio-lateral static balance test and correlate it with TUG and Berg Balance Scale. The BD was assessed by BR. The interclass correlation for BR = 0.942.[21]
In present study, moderate positive correlation of BTWT with TUG is found.

TUG has been used as a basic gold standard of performance- based mobility measure in clinical settings with high reliability and validity in assessing transfers, walking balance, two turns[22] like BTWT, TUG also takes lesser time, equipments and minimal cost for administering in clinical settings.

The present study result BTWT can be used as one of the good clinical test for assessing the balance like TUG. TUG assess only walking ability and turns and transfers but BTWT assess backward disequilibrium which is one of the major cause of fall in elderly and there is no as such test to assess it dynamically, i.e., during walking.
Secondly, BTWT is found to be moderately positive correlated with FSST. FSST is used to assess integrated function of balance by means of checking various components. In FSST subject has to changes direction in forward, backward and sideway. He takes eight steps over the low obstacles with six 90 degrees turns with one 180 degree turn. Various studies give the evidence of importance of FSST as a balance assessment tool. Wayne Dite et al(2002) in their study they stated that FSST requires subjects to rapidly change direction while stepping forward, backward, and sideway, over a low obstacle, while time to complete the test is measured. They found the validity and reproducibility of the FSST and to establish its degree of concurrence with the Timed Up and Go (TUG) test, Functional Reach Test (FRT), and Step Test. The interrater reliability for the FSST was found .99 and intrarater reliability was found .98. Evidence for validity of the FSST was found through its strong correlations with the TUG and Step Test[23]
BTWT is also found to be positively correlated with LST but there correlation is very poor. Value is 0.31 which give little evidence in support of using these test as tools to check balance.

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R. S. Hinman et al(1993) did their study on OA patients with balance impairment they stated that the step test is a functional, dynamic test of standing balance, with reliability and validity. Subjectsinstructed to maintain balance on one leg, while stepping thecontralateral limb on and off a 15-cm step as quickly as possible.The number of times the participant could place the foot uponto the step and return it to the floor over a 15-s intervalwas recorded. The steptest revealed that patientswith OA took significantly fewer steps when standing on theosteoarthritic limb compared with controls[24] present study also shows the same results.

But present study shows some other aspects that LST is found to be moderately positive with FSST. FSST has been used as a balance assessment tool in various studies but no literature reveals a perfect tool for assessment of lateral instability. But with LST can check lateral instability as it is also the one of the causes of fall in elderly population especially in neurologically ill cases like that of stroke as well .

Conclusion

Backward falls are neglected area in elderly population. In the present study BTWT is being used to asses BD and has been found to be moderately correlating with mobility measures i.e. TUG and FSST (r=0.61, 0.57 and p= 0.01) and fairly correlating with balance measures i.e. rLST and lLST (r= 0.39, 0.31 and p=0.05) respectively

Limitations of study

The present study did not include faller which could have given more predictive value for BTWT and BD.In the present study the sample size was small, so sub-group analysis could not be done.68.7%male and 31.25% female were included in the study. Since, less than 1/3 of sample was female this could have resulted in gender bias.

Clinical Relevance

The BTWT is inexpensive and no equipment and clinical set-up is required to carry the procedure. So BTWT can be used as an additional tool to assess BD.

Future study

The future studies can analysis BD in fallers which could tell the better reason of disequilibrium related to fall. The test-retest reliability of BTWT can be measure in future studies.BD occurs usually above the age of 65 years as given in previous studies, which subgroup of elder person affected most could be determine and other testing methods for BD can be tested and verified to give fruitful result.

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