DOI: https://doi.org/10.53350/pjmhs2115123467

**ORIGINAL ARTICLE**

# Effects of Gaze Stability Exercises with Proprioception Training to Improve Gait and Functional Independence in Cerebellar Ataxic Patients

TEHREEM MUKHTAR[1], ADNAN AFZAL PT[2], SARA HUSSAIN[3], MISBAH WARIS[4], RABIA MAJEED[5], SADAF WARIS[6]
[1]*Assistant Professor Riphah International University, Lahore*
[2]*Clinical Physiotherapist PT Care Clinic*
[3]*Physiotherapist*
[4]*Assistant Professor Avicenna Medical and Dental College, Lahore*
[5]*Lecturer University of Management and Technology, Lahore Campus*
[6]*Senior Lecturer Avicenna Medical and Dental College, Lahore*
*Corresponding author: Sadaf Waris, Email: dr.sadaf54@gmail.com, Cell: 0308-8112501*

## ABSTRACT

**Objective**: To compare the effects of gaze stability exercises with proprioception training to improve gait and functional independence in cerebellar ataxic patients.

**Methods**: A Quasi experimental study was conducted in the physiotherapy department in Lahore General Hospital, Lahore, Pakistan from January 2018 to June 2018.All patients were diagnosed with cerebellar ataxia and referred by neurophysician to physiotherapy department. Forty-six (46) patients were divided into two equal groups by lottery method. (Group A =proprioception training), (Group B =gaze stability with proprioception training). Data was analyzed by using statistical package for social sciences (SPSS) 21.

**Results:** In group A, males were 13(56.5%) and females 10(43.5%) while in Group B, males were 12(52.2%) and females 11(47.8%). Mean ages were (71.3±8.47) years in Group A and (70±7.67) years in Group B. Pre and Post Functional Independence Measure (FIM)score in groups A and B with mean and standard deviation were 13.08±1.86 and 15.43±1.74 respectively. Pre and Post Timed Up and Go (TUG) test score in groups A and B with mean and standard deviation were 0.79± 0.26 and 0.97 ±0.39 respectively. Both groups were statistically significant (P value ≤ 0.05) but on the basis of mean ± standard deviation Group B method was more effective than Group A.

**Conclusion:** Gaze stability exercises added the effects of proprioception training in improving gait and functional independence in cerebellar ataxic patients.

**Keywords:** Cerebellar ataxia, gaze, patients, proprioception

## INTRODUCTION

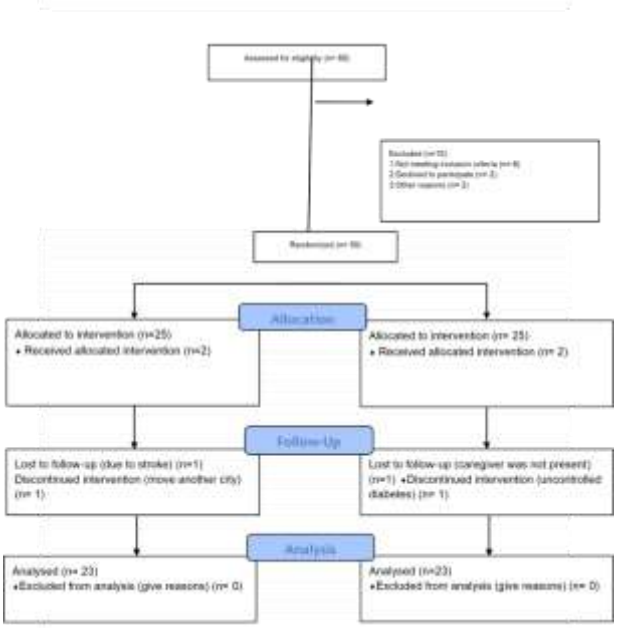
The cerebellum maintains the homogeneity and accuracy of actions required for focused motor action.[1]The vestibular part of cerebellum play a major role in coordinated movements of the eyes and head.[2] Cerebellar ataxias are non-specific clinical manifestations indicating cerebellar dysfunction and its connections, such as the proprioceptive, visual, and vestibular systems, as well as their interconnections. Ataxia, hypotonia, asynergy, dysmetria, nystagmus, dysdiadochokinesia, tremor, and cognitive failure are all signs of cerebellar dysfunction. Patients that involved only flocculo-nodular lesion they do not maintain their balance even they sit on a chair with eyes open. They drop their capability to walk without lateral shift.[3]The prime role of the sensory-motor and vestibular systems is to uphold steady vision.[4]A study reported that recovery of lower limb after stroke depend upon central pattern generators (CPG) that links with sensory inputs. It is activating the conversion from stance phase to swing phase that contributing to changes in walking speed and reflexes which stimulus the CPG pattern.[5]In ataxic individual after examined the static and dynamic stability, Timed Up and Go (TUG) test is used as performance measure test and its score based on time taken dynamic equilibrium .[6]After given robot assisted balance exercises in supra and infra tentorial stroke, walking speed and tandem gait improved by measuring TUG.[7]A recent study conducted by Marcia Bela's dos et al they compared conventional physiotherapy versus Robot assisted gait training in ataxic patients after stroke, they used TUG test to assess balance in sitting, transfer from sitting to standing, steadiness in ambulation and gait course changes. The FIM questionnaire evaluated neuro psychological and motor disability and independence in activity of daily living.[8]Gaze-stability exercises presented to minimize signs of vertigo and decrease the sign of vestibular complaints.[9]In cerebellar disorder rehabilitation continuous examination is required to define if the results hold and to determine the mechanisms of improved visual perception. Proprioception exercise recommendations usually performed in the way of balancing actions constructed on person prior capabilities and previous injury. Patients with genetic and sporadic cerebellar dysfunctions have an increased risk of falling due to gait abnormalities.[10] Gaze stabilization exercises are indicated in the realm of cerebellar ataxia in order to rectify the Vestibulocular reflex (VOR) and reduce visual blurring with head movement. When performing these exercises, the patient moves their head as swiftly as possible while maintaining a steady stare on a fixed immovable target. The exercises can be done in many planes of motion with different speeds, backgrounds, distances from the target, and positions, such as static standing postures or while moving.[11] The malfunction of the cerebrocerebellar manifests itself as instabilities in resounding out regulated, intentional motions by the extremities, according to researchers. Intentional tremor, aberrant writing, dysarthria, dysmetria, odd alternating motions, and hypotonia are among them.[12.] Eye movement problems can cause (a) "difficulty maintaining the usual ocular posture" and (b) ocular motion. If you have trouble "maintaining the regular eyes position," you may notice that your eyes do not move in the same direction or by the same amount.[13]Acquired brain damage can induce hemiparesis, aphasia, cognitive deficits, dysphagia, visual impairments, neglect, ataxia, and vestibular dysfunction, according to researchers and physicians.[14]The vestibular system's part in this synchronized effort is to evaluate linear and angular acceleration of the head, which delivers vital information required to keep upright stance and spatial placement. Vestibular information is united with vision and proprioception such that precise feed forward and feedback control of motor action may be demonstrated.[15] The cerebellum is strongly linked to the relationship between our outgoing motor orders and their anticipated sensory relevance, according to research.[3] When the cerebellum is disrupted or injured, it can result in less informing of motor commands when sensorimotor estimation is required.[16]

The goal of this research was to examine the impact of gaze stability exercises combined with proprioception training vs proprioception training alone. With the best of researcher knowledge, the added effect of gaze stability with proprioception training exercises has not been addressed yet to improve gait and functional independence in cerebellar ataxic patients. Although these techniques were used to improve balance previously.

## MATERIAL AND METHODS

This comparative study was conducted at the physiotherapy department in Lahore General Hospital, Lahore, from January 2018 to June 2018. Sample size calculated by using formula n = $[(Z_{\alpha/2} + Z_{\beta})^2 \times \{2(ó)^2\}]/ (\mu1 - \mu2)^2$. Sample size of 46 cerebellar ataxic patients was taken and divided into two groups. Sample size at 95% confidence interval and 5% level of significance attributing with 80% (0.84) power of study.[8]

All patients were diagnosed with cerebellar ataxia by neurophysician after approval from the institutional ethics committee. All patients of either gender aged between 50 – 89 years and able to walk with assistive walking device for 10m were included[17] after taking consent, while those having spasticity or contracture that affecting gait, use of any ankle-foot orthosis were excluded.(Figure–1)The informed consent form approved by Riphah International University Ethic Committee was signed and approved.




Figure–1: Consort flow chart

Demographic information and history were done. Patients had been guided about exercises and were included in study after their informed consent. Subjects were divided in 2 equal groups by using simple random sampling technique i.e. the lottery method. Among them Group A received proprioception training only. Patients of group A used some of training strategies like ankle disc, balance board and the soft mat for both lower limbs and completed their weight bearing exercises. The participants also completed every exercise by doing sixteen to eighteen repetitions. These exercises were executed by using the one leg stance with slight of knee flexion, and eyes open, barefooted and with the hands placed on their waist. Every of these exercises comprises of four sets with forty seconds of the rest time given among each set of exercise and extensive rest of three minutes was permissible amongst different manoeuvers in command to avoid tiredness. Complete time of exercise training session was sixty minutes, which included ten minutes of warm up and the cool down period of ten minutes also included. [18]Along with proprioception training, Group B did the gaze stability exercise. Patients in group B received proprioception instruction first, followed by gaze stability training. The subjects were asked to fixate the subject X while remaining on the activity. First the subject was positioned at two hundred centimeters and straight ahead at one fifty up. Second subject was placed either at the level of forty centimeter or down. Patients performed these gaze stability exercises five times a day. By this manoeuvers patient instructed to focus on the fix target. So, head rotate horizontally while keeping the target fix. Same training was also performed for the far distance also; and both these workouts were executed for the duration of two minutes, five times a day.[19]This rehabilitation program consisted of sixteen sessions, three sessions per week and total duration of treatment was four weeks[1].Pre and post scoring were done by using Functional Independence Measure (FIM) questionnaire and Timed Up and Go Test (TUG) test. The collected data was entered and analyzed using SPSS 21. Qualitative variables like age, gender, duration of disease expressed in frequency and percentages. t-test was applied to compare the difference of both treatments in group A and B. Value of $P < 0.05$ was considered significant.

## RESULTS

The total 46 patients were divided in two equal groups of 23(50%) each. In Group A, there were 13 (56.5%) males and 10 (43.4%) females while in group B there were 12 (52.2%) males and 11 (47.8%) females. The mean age was (71.3±8.47) years in Group A and (70±7.67) years in Group B. Among four groups of age, more patients were present in Group 3 (70-79 years) in both groups. Duration of disease from 1-3 years was 8(34.8%) and 7-9 years 8(34.8%) were more common in group A and 4-6 years 11 (47.8%) was more in group B. (Table-1).

Table-1 Demographic of patients in frequency and percentage

| Characteristics | | Group A (control) | Group B (Experimental) |
|---|---|---|---|
| | | Number (Percent) | Number (Percent) |
| Age(years) | 50-59 | 4 (17.4 %) | 3 (13%) |
| | 60-69 | 5 (21.7%) | 9 (39.1%) |
| | 70-79 | 10 (43.5%) | 9 (39.1%) |
| | 80-89 | 4(17.4%) | 2 (8.7%) |
| Gender | Male | 13 (56.5%) | 12 (52.2%) |
| | Female | 10 (43.4%) | 11 (47.8%) |
| Disease duration (years) | 1-3 | 8(34.8%) | 9 (39.1%) |
| | 4-6 | 7(30.4%) | 11 (47.8%) |
| | 7-9 | 8(34.8%) | 3(13%) |

Table-2. Mean and Standard Deviation of Pre and Post FIM Score in both groups

| | | Group A(control) | Group B(Experimental) |
|---|---|---|---|
| Mean± Standard Deviation | Pre FIM | 31.73±4.15 | 38.78 ±8.79 |
| | Post FIM | 44.82±6.02 | 54.21±10.53 |
| | Mean difference | 13.08±1.86 | 15.43±1.74 |
| P value | | 0.001 | 0.001 |

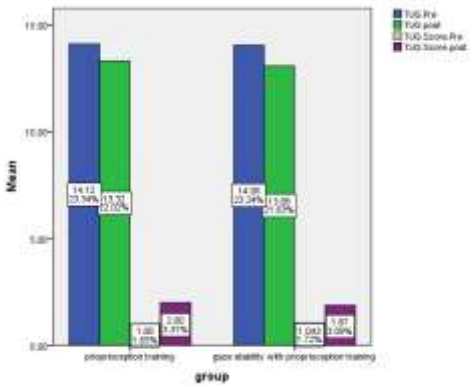



Figure 2: Pre and Post TUG Score

Table shows that mean difference was 13.08±1.86 in Group A while in Group B was 15.43±1.74. Both techniques are statistically significant (as P value ≤ 0.05) But on the basis of Mean ± Std. Deviation Group B was more effective than Group A. (Table-2).

In Group A, Pre and Post TUG score were 23.34% (14.12), 22.02% (13.32). In Group B, Pre and Post TUG. Pre and Post TUG Score were 23.24% (14.06), 21.63% (13.08) respectively

## DISCUSSION

In this study it was concluded that among total patients 45.65% (n=21) were female and 54.35% (n=25) patients were male. It is similar with a study conducted by Chital et al they determine the effect of gaze stability exercise along with proprioception training to improve balance in cerebellar ataxia in their study number of male were more as compared to female.[1]

Age group was 50-89 years. In this study most prevalent age of ataxic patients were initiate between 60-79 years it was comparable with the study that was conducted by Joan A. O'Keefe et.al. on Gait and Functional Mobility Deficits in Fragile X-Associated Ataxia.[20]A study conducted by Lehnen N, Kellerer S,et al. they concluded that head movement seems to improve dynamic vision, enhancing both VOR function and compensatory saccade strategies.[21] In current study group B performed gaze stability exercises with baseline treatment. Result shows clinically significant improvement was seen in Group B. Gaze stability exercises with proprioception training significantly improve balance in cerebellar ataxic patient[1].This study shows that gaze is an important element for rehabilitation of ataxic patients. Decreased velocities of vertical saccades is not rare in cerebellar disorders, it is frequent phenomenology seen in multisystem involvement that substantially involves the cerebellum.[22] The relationship between ataxia and Subject Visual Vertical is logical as decreased control of the body's movements, as occurs in ataxia, can lead to decreased balance and ultimately their gait is affected. The inputs received from the somatosensory, vestibular, and visual systems, it is not surprising that visual dependence (more or less) is related to postural control.[23]This study shows that after 4 weeks of proprioception training, no significant difference is recorded in pre and post TUG score in both groups it is similar to a study that is conducted by of Fonteyn et al. their study shows to improve gait in Spinocerebellar ataxic patients by 5-week treadmill training program. Individuals focused on gait adaptability and utilized projected visual cues to simulate obstacles. After training, there was a significant improvement in the SARA score; however, there were no changes in TUG, or 10-meter walk test (10mWT) scores.[24] In this study, functional independence was assessed with Functional Independence Measure FIM Questionnaire as it is a system that allows for evaluation of many components of independence in activities of daily living[8].Miyai et al investigate the effects of a multidisciplinary inpatient rehabilitation programme in ambulant participants with SCA. Interventions included strengthening and balance exercises, relaxation, coordinative and dual motor task practice, and gait, stair climbing, and activities of daily living practice. Facilitatory tactile and verbal techniques were applied to improve motor learning. Furthermore, significant within-group outcomes with an examination of the percentage of improvement in the SARA, FIM, and BBS suggest that improvements in balance can occur at 3 weeks, and improvements in ataxia require a minimum of 4 weeks. FIM, SARA, gait velocity, and number of falls significantly improved in ataxic patients. The duration of therapy required for functional gains is less clear. Intensity appears to similarly impact the effectiveness of interventions.[24]It was concluded that TUG Pre and Post changes within groups mean difference of Mean± Std. Deviation Group B and Group A were .97 ±.39 and .79± .26 respectively this is accordance with a study that was conducted by Marcia Bela's, Clarissa Barros de Oliveira et.al in 2018 they performed robotic assisted and therapist assisted training in cerebellar ataxic patients and asses by using TUG and FIM score[8].

## CONCLUSION

This study concluded that gaze stability exercises along with proprioception training was more effective in improving gait and functional independence than proprioception alone in patients with cerebellar ataxia.

**Disclaimer:** None to declare.
**Conflict of Interest:** None to declare.
**Funding Sources:** None to declare.

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