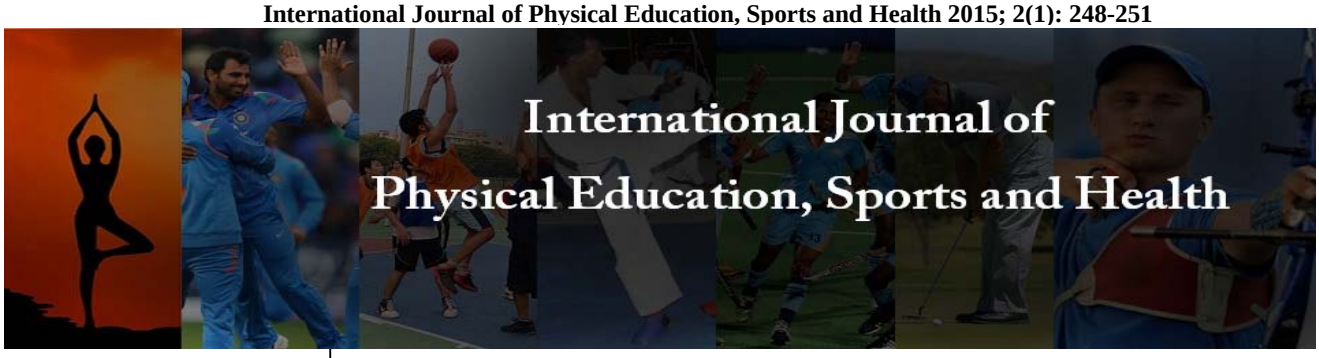

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Effect of gaze stability exercise along with proprioception training to improve balance in cerebellar ataxia

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Abstract
Background: Cerebellar disorders typically manifest with ataxia- incoordination of movement, instability of gait, impairment of articulation, and difficulty with eye movement and swallowing. Proprioception prescription is often given in terms of balancing activities based on patient starting abilities and prior injury Gaze-stability exercises have shown to decrease symptoms of dizziness and increase function in individuals with vestibular disorders objective of the study was to find out whether the effect of proprioception training alone will improve balance in cerebellar ataxia or to find whether the effect of gaze stability exercise along with proprioception training will improve balance in cerebellar ataxia..
Methods and Material: A Total of 30 subjects who fulfilled the inclusion and exclusion criteria were included in the study. All of the subjects were diagnosed with cerebellar ataxia by a Neurologist and referred for physiotherapy, they were randomly divided into two groups by convenience sampling. Group A =15 (Gaze stability exercise along with proprioception training) Group B= 15 (Proprioception training).
Results: shows there was an improvement in Pre to Post scores of BBS and FRT for both the groups, but when comparing both the groups, there was a drastic improvement in scores of BBS and FRT in group A when compared to group B with p- value <0.0001.
Conclusions: Results suggest that Gaze stability exercise along with proprioception training was more effective in improving balance than proprioception training alone in patients cerebellar ataxia

Keywords: Cerebellar ataxia, Gaze stability exercises, proprioception training.

1. Introduction
The cerebellum, lies dorsal to the pons and medulla, consists of two highly convoluted lateral cerebellar hemispheres and a narrow medial portion, the vermis. It is connected to the brain by three pairs of dense fiber bundles called the peduncles. The cerebellum promotes the synchrony and accuracy of movement required for purposeful motor activity. The cerebellar, lesion and coordination of muscular activity are important in skilled voluntary movement, as well as in the movements of posture and equilibrium. The vestibule-cerebellum also controls eye movement and coordinates movements of the head and eyes. Because of the close relationship between the vestibule-cerebellum and the vestibular system, damage to this region of the cerebellum causes clinical findings that mimic vestibular disease itself. Such disorders cause disturbances of locomotion and equilibrium, with prominent truncal and gait ataxia. Patients with isolated flocculo-nodular lesions lose their ability to stand or walk without swaying or falling and tend to fall even when sitting with their eyes open. Abnormalities of posture and station (e.g., head tilt) and of eye movements also occur [1].
Cerebellar disorders typically manifest with ataxia- incoordination of movement, instability of gait, impairment of articulation, and difficulty with eye movement and swallowing. Many diseases involve the cerebellum and produce ataxia, which is characterized by incoordination of balance, gait, extremity and eye movements, and dysarthria. Cerebellar lesions do not always manifest with ataxic motor syndromes [2].
Three abnormalities of eye movement are described which are indicative of cerebellar system disorder, namely, beating nystagmus, failure to maintain lateral gaze either in darkness or with eye closure, and slow drifting movements of the eyes in the absence of fixation. These abnormalities of eye movement, together with other signs of cerebellar disease, such as rebound, alternating, and gaze paretic nystagmus [3].

Proprioception training prescription is often given in terms of balancing activities based on patient starting abilities and prior injury. Balance has an integral association with proprioception as it is a basic coordination of three systems viz. the visual system, the auditory system, and the proprioceptive afferent system, hence any balance exercises is useful for improving proprioception [4].

Mechanoreceptors conveying proprioceptive information are often labelled as proprioceptor. Mechanoreceptors located at the surface of the body, and portions of the vestibular apparatus responsible for conveying information regarding the orientation of the head with respect to gravity. The review of articles found some evidence that proprioception exercises were helpful in cerebellar ataxia [5].

Gaze-stability exercises have shown to decrease symptoms of dizziness and increase function in individuals with vestibular disorders. The preliminary results of this study indicate that this exercise intervention leads to a reduction in the self-report measure of the impact of symptoms on the ability to function, a decrease in the sensitivity to movements, and an improvement in the ability to see clearly during head movements. Continued investigation is needed to determine if these results will hold, to determine if there are different effects of the two interventions, and to determine the mechanisms of improved visual acuity [6].

The interpretation proposed is that the convergence of the eyes at near distance is not only used to weigh the angular size of retinal slip motion resulting from body sway but it also improves the postural stability via efferent and afferent proprioceptive oculomotor and perhaps neck muscle signals [7].

Objective of the study was to find out whether proprioception training will improve balance in cerebellar ataxia and to find whether the gaze stability exercise along with proprioception training will improve balance in cerebellar ataxia.

2. Materials and Methods

The study was conducted at Sagar clinics, Hospitals and Rehabilitation centres, Bangalore. The Ethical clearance has been obtained from the Ethical committee of Dayananda Sagar College of Physiotherapy, Bangalore, as per ethical guidelines research from biomedical research on human subjects, 2001, ICMR, New Delhi. The study design was experimental with pre-post test design. A Total of 30 subjects were taken. All of the Subjects were clinically diagnosed as cerebellar ataxia, who fulfilled the inclusion criteria were included. Subjects between the age group of 50 – 85 years**,** both males and females were included. Patient with BBS score between 45 to 50 was included. Patients with FRT score minimum of 7 inches was included. Exclusion criteria were Non cooperative patients, Contracture or spasticity affecting gait and requiring an ankle-foot orthosis, an orthopaedic shoe or the use of a cane. Other Neurological diseases except cerebellar disorder (vertigo, VBI), Cardio vascular diseases and Visual impairment. Subjects selected for the study were randomly allocated into two groups by Convenience sampling, for this purpose randomization is done by allocating subjects with odd number to control group and even number to experimental group. Group A (n=15) received Gaze stability exercise along with Proprioception Training and Group B (n=15) received Proprioception Training only.

Procedure includes Group A (Gaze stability exercise along with proprioception training): In a group A the subjects first performed proprioception exercises and then followed it up with gaze stability exercise. Subjects were placed on the platform and were asked to fixate the X target. First the target was placed either at 200 cm or at straight ahead or at 15^0 up. Second target was placed either at 40 cm or down. The subjects performed five times a day repetitions of gaze exercise. Exercises were performed in two different manners one was for a distance of (200cm) and second was for a distance of (40cm) [7]. In this way patient was instructed to focus on the target near the patient and horizontally rotate the head keeping the target still. The patient was instructed to focus the eyes on a near target. While focus was maintained the patient horizontally rotated the head and the target in opposite direction. Same exercise was performed for far distance also, both exercises were performed for 2 minutes, five times a day [8]

Group B (Proprioception Training): Participants given Proprioception training, the subjects performed weight bearing exercises using different training device like soft mat, ankle disc, balance board, air cushion for both lower limbs, the subjects performed 16 to 18 repetitions. Exercises was performed in one leg stance which was performed with knee slightly bent (approx.30^0) barefoot, eyes open and with hands resting on waist and each exercises consisted of four sets which was performed for 20s with a 40s rest period given between each set and a longer rest of 3 minutes was allowed between different devices in order to avoid fatigue and total of each training session was 60 min, including a 10 min warm up and a 10 min cool down and co- ordination and gait training exercise were also given [9].

Rehabilitation program The rehabilitation program consisted of 16 to 18 sessions (three sessions per week for four weeks, each session lasting 1 hours) comprised of different exercises (each lasting 1 minute) aiming to improve static and dynamic balance. Co-ordination exercises and gait training were performed under the supervision of a physical therapist with support when required.

Data analysis was performed using SPSS software (version 17). Alpha value was set at 0.05. Descriptive statistics was used to find out mean and standard deviation (SD) for demographic and outcome variables., Paired –T test was used to find out homogeneity for base line and demographic and outcome variable, Unpaired –T test was used to find out homogeneity for base line and demographic and outcome variable, Wilcoxon test was used to find out homogeneity for base line and demographic and outcome variable, Mann-Whitney test was used to find out the homogeneity for base line and demographic and outcome variable.

3. Results & Discussion

3.1 Results

Table1 shows Base line characteristics of 30 subjects shown in the table 1, Mean age of group A was 65.80 and group B was 61.53 which was not statistically significant (p>0.110). Group A male and female ratio was 11 and 4 respectively and in group B was 11 and 4 which was not statistically significant (p > 0.269).

Table1: Baseline data of the study subjects (n=30)

Variable	Group A	Group B	p-value
Age	65.80±7.04	61.53±7.10	>0.110
Gender (M/F)	11/4	11/4	=1

Table 2 shows with in comparison of Pre and Post scores of BBS and FRT for Group A. Pre BBS Score was 46.53 with standard deviation of 0.99 was increased to 54.87 with standard deviation of 0.74 and was statistically significant with p- value <0.0001.Also Pre FRT Score was 10.83 with standard

deviation of 1.00 was increased to 15.35 with standard deviation of 0.74 and was statistically significant with p- value <0.0001.

Table 2: With in comparison for group A

Variable	Pre	Post	p-value
BBS	46.53±0.99	54.87±0.74	<0.0001
FRT	10.83±1.00	15.35±0.74	<0.0001

Similarly Table 3 shows with in comparison of Pre and Post scores of BBS and FRT for Group B. Pre BBS Score was 47.60 with standard deviation of 0.91 was increased to 51.67 with standard deviation of 1.11 and was statistically significant with p value <0.0001. Pre FRT Score was 11.75 with standard deviation of 1.19 was increased d to 12.83 with standard deviation of 1.79 and was statistically significant with p- value <0.0001.

Table 3: With in comparison for group B

Sl. No:	Variable	Pre	Post	Þ-value
1	BBS	47.60±0.91	51.67±1.11	<0.001
2	FRT	11.75±1.19	12.83±1.79	<0.0001

Table 4 shows difference between both the groups. Group A Post Mean BBS was 54.87and standard deviation 0.74 and Also for Group B Post Mean BBS is 51.67 with Standard deviation 1.11 and was statistically significant with p-value <0.0001. (Graph 7) Further post FRT mean for Group A is 15.35 with standard deviation of 0.74 and Group B is 12.83 with standard deviation of 1.79 and was statistically significant with p -value of <0.0001.(Graph 8)

Table 4: Difference between groups

Variable	Experimental	Control	p-value
BBS	54.87±0.74	51.67±1.11	<0.0001
FRT	15.35±0.74	12.83±1.79	<0.0001

3.2 Discussion

The purpose of the study was to evaluate the effectiveness of Gaze stability exercise along with proprioception training to improve balance in Cerebellar ataxia Descriptive Statistics were used for outcome variables i.e. BBS and FRT. Our evaluation criteria were chosen to target effect of Gaze stability exercise along with proprioception training.

For Group A performed Gaze stability exerciss along with proprioception Pre BBS Score was 46.53 following treatment the Post test score was 54.87 and was statistically significant with p-value <0.0001.Also Pre FRT Score was 10.83 following treatment the post test score was 15.3 and was statistically significant with p-value <0.0001. The significant difference was seen in BBS scores in Group A due to usage of Gaze stability exercise along with Proprioception training technique as it mainly focus on to improve balance in Cerebellar Ataxia. This is accordance with the study done by Courtney D. Hall showed The addition of vestibular-specific exercises to standard balance rehabilitation resulted in greater reduction of fall risk in older adults with dizziness and no documented vestibular deficits. Use of vestibular exercises as a component of exercise programs for elderly individuals who may be at risk for falls [10] and Matthew Scherer, *et al* showed, each subject demonstrated a reduction in the ratio of compensatory saccades to head impulses after vestibular physical therapy. Preliminary data suggest that active gaze stability exercises may contribute to improvements in dynamic visual acuity in some individuals [3].

Also for Group B Pre BBS Score was 47.60 following treatment the post test score was 51.67 and was statistically significant with p-value <0.0001. Pre FRT Score was 11.75 and the Post test score was 12.83 and was statistically significant with p value <0.0001.The significant increase in BBS for both the groups was due to usage of Proprioception training in found to provide a statistically significant greater improvement in balance. This is accordance with the study done by B. Missaoui, P. Thoumie showed ataxic patients can improve their balance with better results in dynamic conditions and that the relative contribution of proprioceptive and visual inputs may depend on the extent of somatosensory loss. The first result is to confirm that patients with different levels of proprioceptive ataxia can benefit from a rehabilitation of balance [11]. This is accordance with the study done by W. Taube, M. Gruber showed after proprioception training, subjects were tested while compensating for a rapid posterior displacement of a support surface. This could be the reason that both the groups showed improvement in FRT [12].

However on comparison between both the groups; Group A Post Mean BBS Score was 54.87 and Also for Group B Post Mean BBS is 51.67 and was statistically significant with p-value <0.0001. Further Post Mean FRT Score for Group A was 15.35 and Group B was 12.83 was statistically significant with p-value of <0.0001. The scores of BBS and FRT have statistically increased in both the groups post treatment, but when compared in between the groups Statistical difference was more in case of Experimental group when compared to Control group. This is accordance with the study done by Kathlen E. Cullen, *et al* showed, This statistical significance could be due to vestibular nucleus receives direct input from structures which could carry an efferent copy signal including premotor neuron within oculomotor and gaze control pathway. Projection from these structure could be provide the vestibular cues that could be used to dissociates between active and passive head rotation [13].

This is accordance with the study done by Americo A. Migliaccio, G. Michael Halmagyi showed Also this is hypothesis that during natural activities such as walking or running that proprioceptive awareness is mediated through mechanoreceptors is activated at same time the gaze is stabilize by a combination of visual and vestibular reflex a known as visually enhance vestibule-ocular reflex(VOR).This could be the reason that why Gaze stability exercise along with Proprioception training is more effective when compared to proprioception training alone [14]. Hence our study shows gaze stability exercise is an effective treatment to improve balance in cerebellar ataxic patient. Therefore, this study accept the Research hypothesis and rejecting null hypothesis stating that Gaze stability exercise along with proprioception training is more effective to improve balance in cerebellar ataxia better than proprioception training alone.

Limitations of the study small sample size used, short study duration, Study can be done in gender specially. In this study we did not keep a control group to find the effect of normal treatment approach. Further Recommendations The future scope of the study include the studies with a larger sample size should be conducted, studies with longer duration are recommended, recommendation for longer follow up for long term benefits, studies with different treatment combined with our treatment approaches can be done, studied further in treatment of cerebellar ataxia, study can be done to randomize control trail.

4. Conclusion

The results show significant improvement in both the Groups for BBS and FRT but when compared between groups. Group A was found to be more effective than Group B in improving balance subjects in Cerebellar Ataxia. Hence, this study concluded that Gaze stability exercise along with proprioception training is more effective in improving balance in patients with Cerebellar ataxic than with proprioception alone.

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