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ORIGINAL ARTICLE

To Compare the Effectiveness of Dual Task Training Versus Task Oriented Circuit Training Along with Conventional Therapy on Balance in Patients with Ataxia

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ABSTRACT

Background: Patients with ataxia tend to have most issues with balance as people disturb the path of cerebellar or sensorial communication. Conventional treatment procedures primarily involve individual activities and cannot entirely deal with everyday functioning problems. To evaluate and compare the effects of Dual Task Training (DTT) and Task-Oriented Circuit Training (TOCT), both incorporated with Conventional Therapy (CT) on improving balance and quality of life in ataxic patients, the study was carry out a crossover clinical trial.

Objective: To evaluate the comparative effectiveness of dual task training and task-oriented circuit training combined with conventional therapy for enhancing balance in patients with ataxia.

Methods: Fifty-eight subjects with ataxia were randomly selected and divided into two groups. Group A was given DTT conjoined with CT, whereas Group B was given TOCT with CT. Both groups had three sessions per week for 12 weeks. The Berg Balance Scale (BBS), Scale for the Assessment and Rating of Ataxia (SARA), and EQ-5D-5L to measure quality of life were used at baseline, week 6, and week 12.

Results: Both groups experienced significant improvements in balance and quality of life throughout the 12-week intervention. Nevertheless, the group undergoing

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Task-Oriented Circuit Training along with Conventional Therapy showed significantly superior gains in balance measures and EQ-5D-5L index scores compared to the group receiving Dual Task Training with Conventional Therapy at the 12-week. Overall, the Task-Oriented Circuit Training group demonstrated greater enhancements in both balance and quality of life.

Conclusion: Task-Oriented Circuit Training along with Conventional Therapy improved balance and quality of life more than Dual Task Training. These findings justify using task-based circuit training in rehabilitation to achieve better functional results. Future studies should target larger samples and further follow-ups.

KEYWORDS

• Ataxia, • Dual Task Training • Task-Oriented Circuit Training • Neurorehabilitation • Berg Balance Scale • Balance rehabilitation • Scale for the Assessment and Rating of Ataxia

INTRODUCTION

Ataxia is a neurological condition that significantly impairs walking, balance, and coordination. As such, it is a major issue in neurological healthcare around the world.[1] Typically, patients have a number of characteristic symptoms such as dysmetria (inability to judge distances when moving), tremors worsening with intended movement, dysarthria (poor speech pattern) and an unsteady, wide based walking pattern. The exact way in which ataxia symptoms are manifested depends on which neural pathways are damaged: cerebellar, vestibular, sensory or frontal.[2,3]

Being a coordination centre, the cerebellum processes and integrates information from a variety of sensory systems (proprioception, balance and vision) in order to make exact adjustments of movements. However, when key cerebellar components, such as Purkinje cells, the dentate nucleus or connecting pathways sustain damage, then the integration part fails and produces uncoordinated movements typical of ataxia.[4,5]

Different areas of cerebellar damage produce distinct symptoms. First, damage to the central portion causes damage only to balance and trunk stability and second, damage to the cerebellar hemispheres tends to affect coordination only in certain parts of the body.[4]

Increasingly it has been recognized that far beyond movement control the cerebellum is of significance for cognitive processing such as executive Increasingly it has been recognized that far beyond movement control the cerebellum is of significance for cognitive processing such as executive processing and emotional control, which further increases the complexity of the clinical presentation of ataxia.[6]

Clinical evidence shows that hereditary ataxias affect 6-10 people per 100.000 globally but acquired ataxias caused by stroke, multiple sclerosis, and alcohol-related degeneration further increase the total disease burden.[7,8] Congenital defects, infections, autoimmune diseases, vitamin shortages, hypothyroidism, and pathology in the midline cerebellar regions can all be contributing factors.[9] Geographic differences become apparent since SCA3 mainly occurs in Brazil together with China yet Friedreich's ataxia almost never develops in East Asian populations yet impacts 2-5 patients per 100,000 Caucasian people.[8,10]

Tropical ataxic neuropathy from cassava toxicity together with poor nutrition strikes a maximum of 570 individuals per 100,000 people in resource-constrained areas emphasizing that socioeconomic factors affect disease occurrence rates.[11]"X-linked ataxias with fragile X-associated tremor ataxia syndrome and spinocerebellar ataxias are autosomal dominant ataxias. Worldwide, it is estimated that 3.3 out of 100,000 people have autosomal recessive disease and 27 out of 100,000 have autosomal dominant disease."[12]

Childhood ataxia remains frequently undetected throughout Europe yet manifests in 26 out of 100,000 children although this condition stems from genetic defects including ataxia-telangiectasia as well as post-viral demyelination of the cerebellum,[11,13]The persistent disability of ataxia continues

through life to generate major personal and societal impacts because it reduces employment opportunities and intensifies caregiver responsibilities.[14]

Immune-Mediated Cerebellar Ataxias are diagnosed by a combination of clinical bedside assessment (considering subacute or chronic ataxia and associated signs), autoantibody testing (ie. anti-GAD antibodies and onconeural antibodies; gluten related antibodies) and brain imaging (MRI of atrophic cerebellum). It can be confirmed by analysis of cerebrospinal fluid (lymphocytosis and increased IgG) suggesting an inflammatory cause. Start of immunotherapy treatments (steroids, intravenous immunoglobulin) before permanent neuronal damage occurs is essential and more importantly should not be delayed with prompt diagnosis. The suspected paraneoplastic cases should undergo cancer screening and gluten sensitivity should be tested when gluten ataxia is considered.[15]

Currently, ataxia has only treatment options, most of which are designed to treat symptoms and not the disease itself. Riluzole (for reducing tremor) and acetazolamide (for reducing vertigo) in addition to other medications such as Ropinirole, decreased response to Clonazepan and Tremor settling with Lamictal and Zitoracrturn all provide minimal benefits but are tempered (limited) by frequent side effects including depression and metabolic acidosis,[16,17]

one of these treatments are going to solve the problems of mitochondrial dysfunction or protein aggregation that are underlying mechanisms of spinocerebellar ataxias, including Friedreich's ataxia, but there are some researchers over there looking at potential neuroprotective treatments, for example, omaveloxolone for Friedreich's ataxia that have not really produced the long-term effectiveness data yet. This has led to the still in use of neurorehabilitation in managing ataxia and in the treatment of such patients in order to ameliorate balance control, to develop compensatory techniques for moving around and to support patient's functional independence.[18]

Typical physiotherapy regimes for ataxia including Frenkel's exercises (recurring task training to enhance the coordination between muscles) and proprioceptive neuromuscular facilitation were aimed at building strength and maintaining static balance in single task only.[19] Yet this kind of conventional approach the basic approach that is currently used to understand the cerebellum, but not provide a good explanation for everyday activities like walking and talking while walking or navigating around obstacles is not addressing the cognitive-motor integration necessary in performing everyday activities.[20,5]

The result is a practical disconnect, where such patients might do well in the clinic with their balance exercises, but fail with such dynamic, divided activity as shopping for groceries.[18] This much effectiveness gap has led to an increasing interest in more functional approach such as dual task training (DTT) and task-oriented circuit training (TOCT) that mimics real life task but enhance neuroplasticity and to help patients develop adapt functional skill.[21]

Dual task training requires participants to perform both a motor skill and a cognitive task at the same time (going through obstacles at the same time as counting backward), therefore sufferers have to compensate by reallocation of attention and decrease dual task interference, that is, operating two tasks. concurrently reduces the overall performance quality.[22] Studies in Parkinson's disease and stroke patients also indicate that DTT improves walking speed, stride length, and reduces falling risk by increasing movement automaticity and increasing circuitry between cortical and subcortical brain areas.[23,24]

Early research indicates that dual task training may improve executive function and dynamic balance in elderly individuals with ataxia specifically, and for cerebellar disorders, its effectiveness still needs further research.[22] In comparison, task-oriented circuit training utilizes functional exercise stations such as sit to stand, stairs climbing and stair descending that can be high intensity to strengthen specific movement patterns and recalibrate proprioception. Results from Ali and colleagues (2021) research showed that addition of TOCT to the traditional therapy resulted in much more improvements in balance in patients with ataxia caused by multiple sclerosis than core stability training alone, possibly by refining connections between the cerebellum and motor cortex.[25]

MATERIALS AND METHODS

Aim: To evaluate the comparative effectiveness of dual task training and task- oriented circuit training in combination with conventional therapy for enhancing balance in patients with ataxia.

Objectives of the study

- To assess the impact of dual task training combined with conventional therapy on improving balance in patients with ataxia using Berg Balance Scale and Severity of ataxia rating scale.
- To evaluate the effectiveness of task-oriented circuit training along with conventional therapy on improving balance in patients with ataxia using Berg Balance Scale and Severity of ataxia rating scale."
- To compare the outcomes and evaluate which technique is more efficient for management of balance in ataxia measured by Berg Balance Scale, Severity of ataxia rating scale, EQ-5D-5L scale.

Ethical consideration: The study was approved by the Institutional Ethics Committee of Shri Guru Ram Rai Institute of Medical and Health Sciences (Ref. No.: SGRR/IEC/25/25). Written informed consent was obtained from all participants, ensuring voluntary participation and the right to withdraw at any time. The trial was prospectively registered with the Clinical Trials Registry of India (CTRI/2025/04/084868) on 16th April 2025. A No Objection Certificate for copyright was also obtained from the Department of Physiotherapy (Diary No. LD-23852/2025-CO) on 18th June 2025.

Study design and settings: This comparative experimental study was carried out in the Department of Physiotherapy at Shri Guru Ram Rai University and Shri Mahant Indiresh Hospital, Dehradun. The sample size was determined using G*Power version 3.1.9.7. A total of 58 participants diagnosed with ataxia, aged between 18 and 60 years were selected using random sampling. Individuals were excluded if they were bed ridden, had symptom of unstable cardiac disease, atrial fibrillation, Uncontrolled hypertension, Recent pulmonary embolism, having orthopaedic impairment like recent lower limb fracture, severe joint disorders, severe visual, hearing and cognitive impairment. After screening, eligible participants were randomly assigned into two equal groups: Group A (n=29) received Dual Task Training combined with Conventional Therapy, while Group B (n=29) underwent Task-Oriented Circuit Training along with Conventional Therapy.

Group A: The participants of this group were involved in a 45-minute exercise that consisted of dual task training with conventional therapy. The conventional therapy involved 20min of the following supine exercises (leg raises, knee and ankle movements), assisted calf and hamstring stretch (5 repetitions of 30s) and performance of static balance on unstable foam with opened eyes and with closed eyes. The session was given a rest period of 5 minutes and dual task training included balance and cognitive activities and lasted 25 minutes. The program incorporated balance activities, including sit-to-stand, stance on one leg, tandem walking and backward walking, activities with balls as well as cognitive tasks, including attention games, memory, arithmetic, verbal fluency, and problem-solving. This type of approach was given to enhance motor control and cognitive processing concurrently.

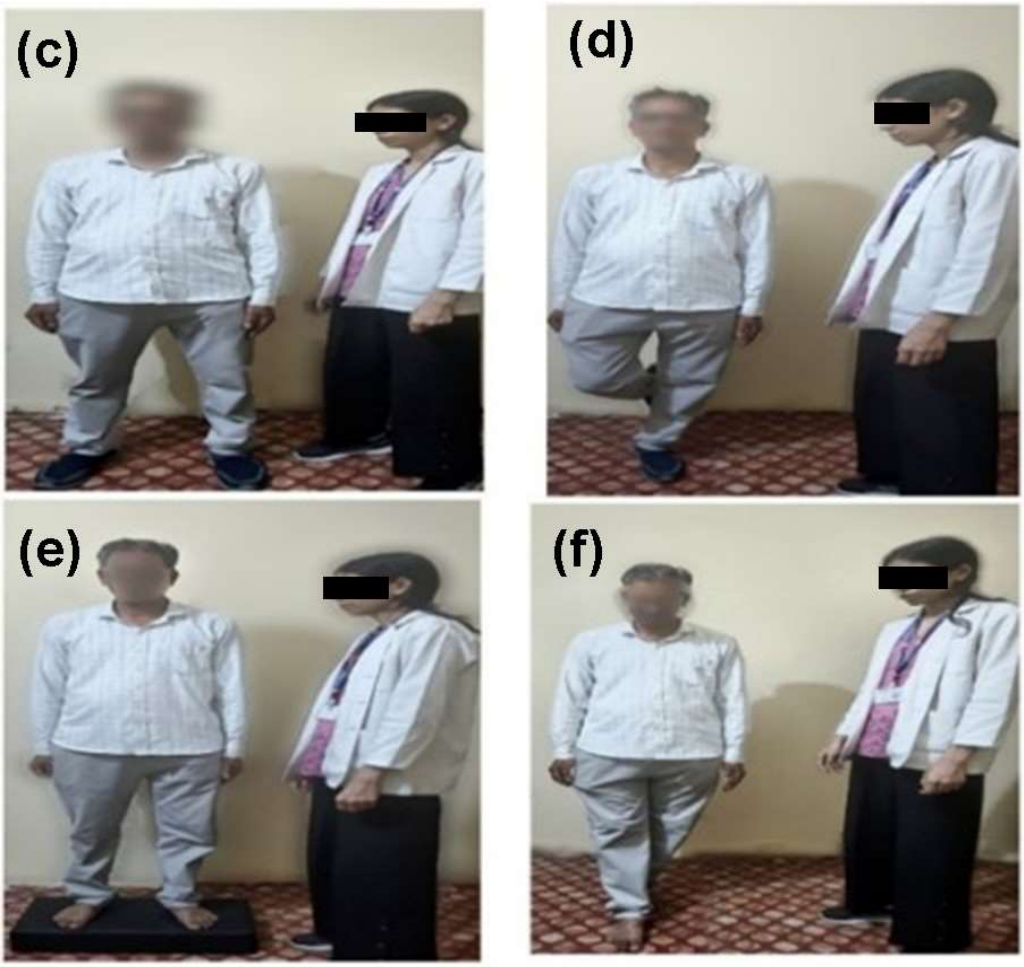


Figure 1 (a-f): Dual Task Training (Performing Balance exercises (like sit to stand, with eyes open standing with feet apart, standing on 1 leg, standing on a soft surface, tandem simultaneously with cognitive tasks)

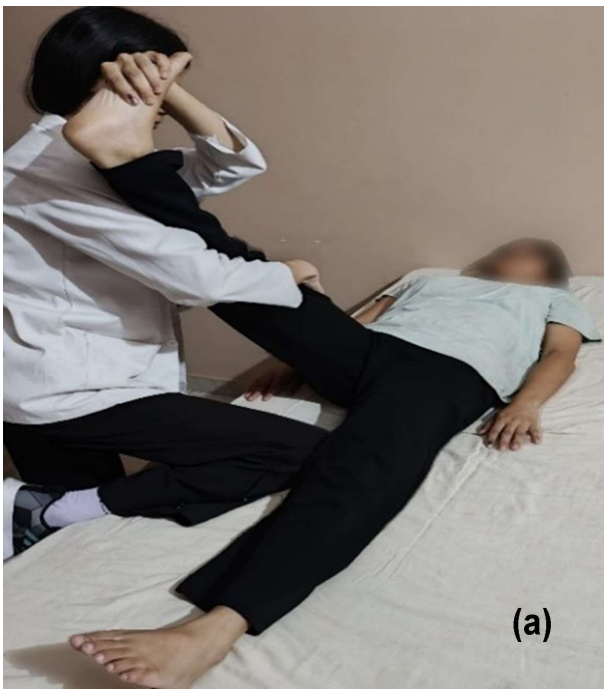


Figure 2: Conventional therapy Performing **(a)** Calf and Hamstrings stretches, **(b)** Static postural control exercises

Group B: The participants of this group were involved in a 45-minute exercise that consisted of task-oriented circuit training with conventional therapy. The conventional treatment given in this group was the same as that which was given in the DTT group for 20min. This group of participants were subjected to 25 minutes of task-oriented circuit training which consisted of a seated activities with sit to stand transfers and short distance walks as participants moved between height difference between the chairs and a Swiss ball. Standing tasks involved reaching activities with increasingly narrow base of support, picking up items on the floor, gait over obstacles, ascending stairs and tandem gait. Activities were organized in such a way that they were conducted more like a circuit and were designed to enhance dynamic balance, coordination, and functional mobility.

Figure 3 (a-d): Task oriented circuit training (Reaching forward and sideward for object in Parallel and Tandem condition)

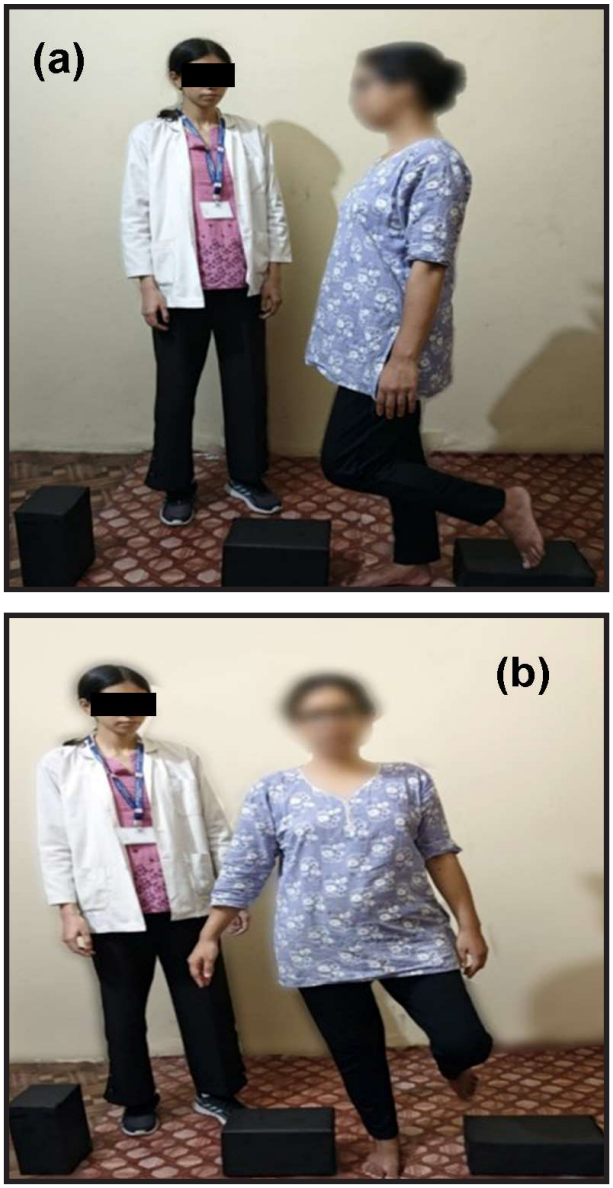


Figure 4 a-b: Task oriented circuit training (Walking forward and sideways above blocks of various heights)

Physiotherapy sessions were conducted for both groups three times a week on alternate days over a 12-week period. Each session lasted 45 minutes. Outcome measures which were Berg Balance Scale (BBS), Scale for the Assessment and Rating of Ataxia (SARA), and EQ-5D-5L carried out at baseline, at the end of the 6th week, and after 12 weeks.

RESULTS

Statistical analysis

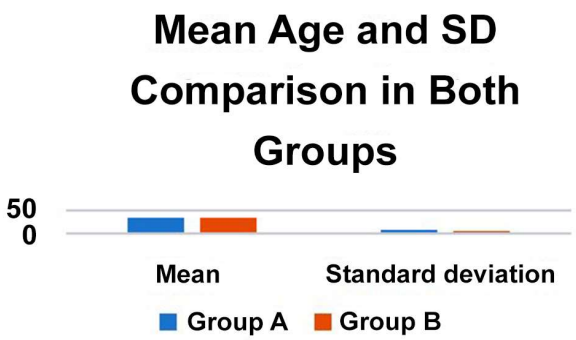
It was carried out physically as well as with statistical software SPSS 23 version and Microsoft word, Excel has been used to

generate graphs table etc. Various statistical measures such as mean, standard deviation, one way ANOVA were utilized for all the scores of participants included in the study.

During the analysis of baseline demographic characteristics, the age distribution of participants was assessed using mean and standard deviation. The baseline age distribution showed Group A (32.5 ± 5.71 years) and Group B (32.7 ± 5.59 years) were comparable, with minimal variation and no significant difference.

Table and Graph 1: Average Age and standard deviation of Participants in Group A and B

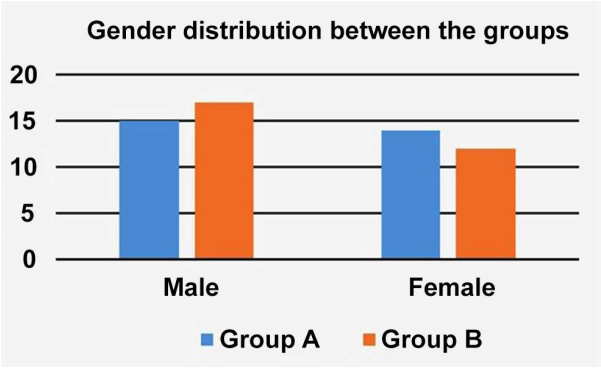
Groups	Mean	Standard deviation
Group A	32.5	5.71
Group B	32.7	5.59



The gender distribution of participants across the two groups, Group A had 15 males and 14 females, while Group B had 17 males and 12 females, indicating a balanced gender distribution with no substantial difference.

Table and Graph 2: Gender-Based Allocation of Participants between Group A and Group B

Groups	Male	Female
Group A	15	14
Group B	17	12



Within-group analysis of Group A showed significant improvements in all outcome measures from baseline to 12 weeks. BBS scores increased from 32.24 ± 1.95 to 37.44 ± 1.72 and 44.13 ± 1.86 (F = 300.89, p = 0.0001), indicating better balance. SARA scores decreased from 12.24 ± 2.49 to 10.87 ± 2.65 and 9.56 ± 2.85 (F = 7.262, p = 0.001), reflecting reduced ataxia. EQ VAS improved from 64.27 ± 2.25 to 72.24 ± 2.08 and 80.96 ± 2.17 (F = 428.58, p = 0.0001), while EQ-5D-5L Index rose from 0.742 ± 0.225 to 0.849 ± 0.026 and 0.925 ± 0.022 (F = 159.664, p = 0.0001), indicating enhanced health and quality of life.

Table 3: Comparison of all the outcome measure within Group A

Outcome Measure	Baseline (Mean±SD)	6th-Week (Mean±SD)	12th-Week (Mean±SD)	F-value	P-value	Result
BBS Score	32.24 ± 1.95	37.44±1.72	44.13 ± 1.86	300.89	0.0001	Significant
SARA Score	12.24±2.49	10.87±2.65	9.56 ± 2.85	7.262	0.001	Significant
EQ VAS Score	64.27±2.25	72.24±2.08	80.96±2.17	428.58	0.0001	Significant
EQ-5D-5L Index Score	0.742±0.225	0.849±0.026	0.925±0.022	159.664	0.0001	Significant

The within-group analysis of Group B revealed significant improvements across all measures over 12 weeks. The BBS Score rose from 32.51 ± 1.57 at baseline to 38.65 ± 1.81 at 6 weeks and 45.55 ± 1.70 at 12 weeks (F = 426.33, p = 0.0001), indicating enhanced balance. SARA Scores declined from 14.08 ± 1.86 to 12.03 ± 2.19 and 10.24 ± 2.48 (F = 22.3, p = 0.0001), showing reduced ataxia. EQ VAS Scores improved from 64.65 ± 2.48 to 72.96 ± 1.84 and 81.96 ± 1.54 (F = 545.86, p = 0.0001), while EQ-5D-5L Index Scores increased from 0.750 ± 0.234 to 0.861 ± 0.013 and 0.940 ± 0.010 (F = 182.56, p = 0.0001), reflecting better perceived health and quality of life.

Table 4: Comparison of all the outcome measure within Group B

Outcome Measure	Baseline (Mean±SD)	6th Week (Mean±SD)	12th Week (Mean±SD)	F-value	P-value	Result
BBS Score	32.51 ± 1.57	38.65± 181	45.55 ± 1.70	426.33	0.0001	Significant
SARA Score	14.08 ± 1.86	12.03±22.19	10.24 ± 2.48	22.3	0.0001	Significant
EQ VAS Score	64.65 ± 2.48	72.96±21.84	81.96 ± 1.54	545.86	0.0001	Significant
EQ-5D-5L Index Score	0.750±0.234	0.861±0.013	0.940±0.010	182.56	0.0001	Significant

The between-group comparison showed statistically significant differences favoring Group B across all outcome measures. Both groups improved, but Group B consistently achieved higher scores: BBS ($p = 0.003$), SARA ($p = 0.002$), EQ VAS ($p = 0.004$), and EQ-5D-5L ($p = 0.002$). These results indicate that while both interventions were effective, Group B's approach yielded superior improvements in balance, ataxia severity, and quality of life.

Table 5: Comparison of all the outcome measure between Group A and Group B

Outcome Measure	Group A–Baseline (Mean ±SD)	Group B-Baseline (Mean ±SD)	Group A-6th Week (Mean ± SD)	Group B-6th Week (Mean ± SD)	Group A-12th Week (Mean ± SD)	Group B-12th Week (Mean ± SD)	t-value	P-value	Result
BBS Score	32.24± 1.95	32.51 ± 1.57	37.44 ± 1.72	38.65 ± 181	44.13 ± 1.86	45.55 ± 1.70	6.012	0.003	Significant
SARA Score	12.24 ±2.49	14.08 ±1.86	10.87 ± 2.65	12.03± 2.219	9.56 ± 2.85	10.24 ± 2.48	4.012	0.002	Significant
EQ VAS Score	64.27 ±2.25	64.65 ±2.48	72.24 ± 2.08	72.96 ± 2.84	80.96 ± 2.17	81.96 ± 1.54	3.012	0.004	Significant
EQ-5D-5L Index Score	0.742 ±0.225	0.750 ±0.234	0.849 ±0.026	0.861 ±0.013	0.925 ±0.022	0.940 ±0.010	5.012	0.002	Significant

DISCUSSION

This research investigated the comparative effectiveness of two rehabilitation approaches Dual Task Training and Task-Oriented Circuit Training for improving functional outcomes in patients with ataxia., with both approaches delivered alongside Conventional physiotherapy over 12 weeks. Fifty-eight participants were randomly assigned to either DTT, which combined cognitive and motor tasks to improve attentional flexibility, or TOCT, which focused on functional movement circuits to enhance postural control and coordination. The study employed four validated outcome measures: Berg Balance Scale (BBS) for balance assessment, SARA for ataxia severity, EQ-VAS for self-rated health status, and EQ-5D-5L for quality of life. Evaluations occurred at baseline, 6 weeks, and 12 weeks, with statistical analyses tailored to the data distribution characteristics. Both groups showed significant improvements across all measures, though TOCT demonstrated particular advantages in balance enhancement as measured by BBS scores. The comprehensive assessment protocol allowed for detailed comparison of these rehabilitation approaches' effects on both physical and quality-of-life outcomes in ataxia patients. The primary objective was to determine which intervention yielded superior outcomes in balance improvement, reduction of ataxia severity, and enhancement of health-related quality of life. The findings revealed significant within-group improvements across all outcome measures for both DTT and TOCT. However, between-group comparisons demonstrated a statistically significant advantage for TOCT in balance improvement, as evidenced by BBS scores. Specifically, the BBS scores in the DTT group increased from 32.24 ± 1.95 at baseline to 44.13 ± 1.86 by week 12, whereas the TOCT group showed a more pronounced improvement from 32.51 ± 1.57 to 45.55 ± 1.70 ($p = 0.0001$) and between-group difference was statistically significant (*p* = 0.003).This underscores the superior efficacy of TOCT in restoring balance, likely due to its emphasis on repetitive, task-specific exercises

that enhance anticipatory and reactive balance mechanisms.

SARA scores showed a significant reduction in both groups, indicating improved coordination and reduced ataxia severity (Group A: 12.24 ± 2.49 to 9.56 ± 2.85; p=0.001 Group B: 14.08 ± 1.86 to 10.24 ± 2.48; p = 0.0001 within groups), and Quality of life also improved in both groups. EQ-VAS scores increased notably (Group A: 64.27 ± 2.25 to 80.96 ± 2.17; Group B: 64.65 ± 2.48 to 81.96 ± 1.54; p = 0.0001 within groups, The between-group difference was also significant (*p* = 0.002). Similarly, EQ-5D-5L index scores rose (Group A: 0.742±0.225 to 0.925±0.022) ; (Group B: 0.750±0.234 to 0.940±0.010), *p* = 0.0001 within groups and between-group difference was statistically significant *p* =0.002 suggesting that both interventions meaningfully enhanced participants' perceived well-being and functional independence.

The improvement in BBS scores in the TOCT group can be attributed to the repetitive, functionally structured exercises that target both anticipatory and reactive balance mechanisms.

This supports findings from Darwish and colleagues in 2019, who demonstrated significant improvements in balance among patients undergoing task-oriented rehabilitation. Similarly, Ali *et al.* in 2021 emphasized the superiority of circuit-based therapies in enhancing postural responses in neurological conditions, likely due to their focus on high-repetition, goal- directed functional tasks. The TOCT protocol in this study incorporated tasks such as stair climbing, object retrieval, transitional activities, and turning, all of which directly challenge and improve dynamic balance and weight shifting strategies. In terms of ataxia severity, as measured by the SARA scale, both groups exhibited significant improvement over the 12-week period. However, no statistically significant difference was found between the DTT and TOCT groups.

This aligns with the research conducted by Ilg *et al.* in 2009, who found that intensive coordination training can reduce the severity of ataxia across different intervention formats. Similarly, a study by Miyai and colleagues in 2012 reported that gait and balance rehabilitation programs can lead to measurable neurological improvements, even in chronic ataxic populations, although not necessarily favoring one method over another. The quality-of-life assessments, including the EQ-VAS and EQ-5D-5L Index score, revealed substantial within-group improvement in both intervention arms. This suggests that structured rehabilitation positively influences patients perceived health status, emotional well-being, and confidence in mobility.

These findings are consistent with the work of Baroni *et al.* in 2022 and Seco Calvo *et al.* in 2014, both of whom reported that sustained engagement in physical therapy leads to significant enhancement in quality of life among individuals with neurological impairments.

Although TOCT appeared superior in improving balance, the Dual Task Training group demonstrated important clinical gains, particularly in the area of dual-task performance. While this improvement may not have been fully captured by the scales used, it likely contributed to better real-life functioning, especially in situations that require cognitive-motor multitasking. Literature by Park in 2022, and Hiyamizu *et al.* in 2011, underscores the value of dual-tasking interventions in improving executive function, attention, and motor performance under cognitive load. These abilities are essential for everyday scenarios such as walking in a crowded environment or responding to verbal instructions while moving, which are often challenging for individuals with cerebellar disorders. From a mechanistic perspective, both interventions contribute to neuroplasticity and functional reorganization in different but complementary ways.

Task-oriented training emphasizes repetition and sensory-motor integration, fostering motor relearning. In contrast, dual-task training engages frontal-subcortical circuits, supporting cognitive flexibility and shared attentional processing. Sarasso *et al.* in 2024 emphasized that engaging multiple brain networks through structured and progressive tasks can promote cerebellar compensation and facilitate cerebello-cortical reorganization. This dual focus on motor and cognitive integration provides a theoretical rationale for incorporating both strategies in clinical settings.

In summary, the present study highlights the functional benefits of two modern

rehabilitation approaches for individuals with ataxia. While TOCT was more effective in improving balance, DTT also produced measurable improvements in coordination, "quality of life, and multitasking ability. These findings support the clinical utility of both interventions and suggest that treatment should be individualized based on the patient's primary functional deficits. A hybrid approach that incorporates both dual-task elements and task-specific circuit training may offer the most comprehensive benefits and should be explored in future research.

Limitations of Study

The study only evaluated outcomes up to 12 weeks, with no assessment of long-term retention or functional independence.

The lack of participant or therapist blinding could have introduced bias in performance or reporting.

While Dual Task Training focused on dual-tasking, the study didn't include direct cognitive outcome measures to quantify executive improvements.

Conducted at one facility, which may limit how generalizable the results are to broader clinical populations or settings.

CONCLUSION

Ataxia needs effective rehabilitation interventional measures capable of treating motor incoordination, balance and functional disability. This research had compared and measured the effects of Dual Task Training (DTT) In contrast to Task-Oriented Circuit Training (TOCT) with traditional therapy on balance, coordination, and self-sustenance of affected people with ataxia. The outcome measures were BBS, SARA, EQ-VAS and EQ-5D-5L Index score.

Both of them had a considerable effect on all parameters. TOCT proved to be more effective in improving postural control and dynamic balance which is measured by increasing BBS scores implying its superiority in enhancing motor relearning activity through repetitive and practical tasks. Although DTT was somewhat less effective in the improvement of balance, it significantly benefited the enhancement of coordination and cognitive-motor integration which has been the implication of DTT in making patients ready to face the challenges of multitasking that they would encounter in their real lives.

Both groups of the psychological benefits of structured physiotherapy are abridged by quality-of-life improvements. These results correlate with the necessity of individual rehabilitation plans motor instability with TOCT prevalence in motor instability and DTT prevalence in cognitive-motor challenges. The combination of the two methods can provide a more detailed and patient-centered model of rehabilitation that can achieve improved functional outcomes in ataxia.

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