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The Effects of Treadmill Training with Visual Feedback and Rhythmic Auditory Cue on Gait and Balance in Cerebral Palsy: A Randomized Controlled Trial

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Abstract: *Patients suffering from cerebral palsy often face difficulties in symmetrical balance and walking. It can affect the posture and movement of affected patients. The current Randomized Controlled Trail (RCT) study was designed to assess the impact of treadmill training on balance and spatiotemporal parameters. Twenty-eight patients were randomly allocated to two groups. Th treatment group (n=14) received treadmill training with visual feedback and rhythmic auditory cues (VF+RAC), while patients in control group only received treadmill trainings. The treatment exercises were given for eight weeks, with five sessions per week. The assessments were made on baseline, 4th, and 8th weeks of study. Berg Balance Scale, Timed Up test, and spatiotemporal gait parameters such as walking speed, stride length, and gait stability were used for assessment. The results showed significant improvements in balance and gait parameters in the treatment group compared to the control group, indicating the effectiveness of treadmill training with VF+RAC. These findings suggest that incorporating visual and auditory cues in treadmill training may enhance balance and gait in children with cerebral palsy, offering a valuable approach for rehabilitation. The study supports the use of VF+RAC as an effective intervention to improve motor function in this population.*

Keywords: Gait Patterns, Hemiplegic Cerebral Palsy, Treadmill Training, Visual Feedback

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1. Introduction

The most common physical disability in children is cerebral palsy. Because of a variety of circumstances, cerebral palsy can have a substantial impact on an individual's movement, posture, and balance (Vitrikas, K et al. 2020). Numerous illnesses reveal themselves at an early stage of life because of injury to the developing brain and endure as permanent and non-progressive difficulties. Every year, roughly 0.2% to 0.3% of live infants are reported to have cerebral palsy. For infants born prematurely or with a low birth weight, the frequency rises to 40–100 per 1000 live births(Krägeloh-Mann et al. 2009). Children who are impacted will have to live with the devastating ailment for the rest of their lives. Although hemiplegia, diplegia, quadriplegia, and total paralysis are four more known kinds of cerebral palsy (CP), monoplegia and triplegia are extremely rare. Spastic hemiparesis is a disorder in which one side of the body is weaker than the other, with the upper limbs being more severely affected than the lower limbs. 56% of infants born at full term will have the disease, whereas 17% will be born prematurely. Pathogenesis is a complex process. Voluntary movement restriction has a major impact on hand function (Sankar, C et al. 2005). Cerebral palsy manifests itself in a variety of symptoms and deformities. While mobility problems are the most frequent, these disorders often entail a variety of anomalies, such as reduced balance and sensory deficiencies. Pain, intellectual disability, impaired walking or speech, hip displacement, epilepsy, incontinence, behavioral or sleep disorders, hearing loss, blindness, and the development of scoliosis due to muscular spasms are all common complications of cerebral palsy (Morgan, C et al. 2021). Cerebral palsy (CP) is a common co-occurring condition with intellectual disability (ID) and seizures. In cerebral palsy (CP), both sides of the corticobulbar and promotor areas are dysfunctional, which results in speech difficulties (Hunziker, S et al 2023).

The causes of CP are numerous and complex. Cerebral palsy is caused by a variety of circumstances and can affect various areas of the brain. Congenital, genetic, inflammatory, viral, anoxic, traumatic, and metabolic variables are among the causes. The growing brain may be damaged during the prenatal, natal, or postnatal periods (Gururaj, A et al 2003).Multiple pregnancies, acidosis, asphyxia, intrauterine growth restriction, chorioamnionitis, intranasal infections, and preterm antibiotic use prior to membrane rupture can all cause brain injury(Novak, I et al 2017). A small proportion of instances can be attributed to intrapartum hypoxia. Cerebral palsy usually appears in elderly patients because of brain trauma or infection. Mother-related variables Cerebral palsy is more common in women who have delayed menstruation, irregular menstruation, or extended intermenstrual intervals. Children with cerebral palsy who had previously experienced neonatal encephalopathy. Neonatal encephalopathy is a well-defined condition characterized by decreased brain function in full-term infants during the first few days of life. It is distinguishable by difficulties starting and maintaining respiration, decreased muscular tone and reflexes, lower levels of consciousness, and, occasionally, seizures (Jiang ZD et al. 2023). Another factor is Pre-eclampsia is linked to a higher likelihood of cerebral palsy in full-term newborns (Nelson, K. B et al. 1999).

To clinically diagnose cerebral palsy, it is critical to understand the risk factors, assess high-risk neonates for developmental anomalies on a regular basis, and do a full neurological examination. A methodical technique must be used to diagnose any medical disease. This method includes examining the kid's developmental milestones, taking a full medical history, observing the child in various situations (such as supine, prone, sitting, standing, walking, and running), and performing a thorough neurological examination. During the diagnosis process, different types of movement disorders, such as ataxia, spasticity (muscle stiffness), or dyskinesia (involuntary motions), may result in separate categorizations. Spasticity, a disorder that impairs motor function, is common in children with cerebral palsy (Swanson SS et al.2023). Neuroimaging is crucial in identifying and describing non-progressive lesions or abnormalities in the growing or immature brain (Aravamuthan BR et al.2021). The utilization of postnatal magnetic resonance imaging (MRI) and perinatal ultrasonography has facilitated the identification of brain damage, permitting prenatal diagnosis as late as six months following delivery (Novak, I et al 2017). MRI is the preferred imaging technique over computed tomography due to its superior specificity (about 89%) in detecting abnormalities within the skull. Brain imaging in patients with cerebral palsy may reveal a diverse array of abnormalities, such as schizencephaly (clefts in cerebral tissue), hydrocephalus, and periventricular leukomalacia (Vitrikas, K et al. 2020). A cerebral palsy kid should be evaluated for visual, linguistic, auditory, sensory, motor abilities, epilepsy, and cognitive deficits. Muscle imbalance and stiffness can cause hip subluxation, horse deformities, contractures, and scoliosis, requiring an orthopedic assessment (Sankar, C et al. 2005).

After a diagnosis, numerous measures can assess cerebral palsy severity and therapy efficacy. The Gross Motor Function Classification System (GMFCS) is responsible for finalizing motor function classification. There are various cerebral palsy assessment techniques, but research has not proved a winner. The Gross Motor Function Classification System (GMFCS) categorizes disability in mobility, body positioning, and stability based on age. At level I, you can move freely, but at level V, you need a wheelchair (Montero-Mendoza, S et al.2019). Most children with cerebral palsy have poor gait function due to involuntary muscle spasms and muscle weakness. As a result, individuals experience limitations in both the structure and activity of their gait. Physiotherapy, orthotics, botulinum toxin injections, oral medicines, and surgical therapies (including orthopedic and neurosurgical operations) are all used to treat spasticity (Han, Y. G et al.2020). Physical therapy is an important part of CP management. Physical therapists (PTs) must be knowledgeable about conservative therapy to help their patients avoid the costly alternatives of surgical procedures and other non-conservative choices for CP, which can place a significant financial burden on families. By immediately intervening, physical therapists can correct gait and musculoskeletal issues using conservative methods. Physical therapists use their gait knowledge to assess patients' level of disability and develop individualized treatments to improve function and slow illness progression (Petrini, M. 2023).

2. Materials and Methods

The Sample Size and Selection Process: During the current RCT, 28 patients affected from Cerebral Palsy (age<18 years) and GMFCS Level I & II were enrolled. Patients with gait issues or any other neurological disorders were excluded from the study. Computer generated numbers were used for the randomization

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process. The patients were randomly divided into treatment groups receiving treadmill training with visual feedback and rhythmic auditory cue (VF+RAC), while control group received training without VF+RAC.

Intervention Protocol: During eight weeks of protocol, both groups received five sessions of training per week. The control group received only treadmill training while treatment group received treadmill training and sensory enhancement through VF+RAC. A screen was placed to visualize the gait feedback, while headphones were used for auditory stimulation. The monitoring and adherence to the protocol was ensured through attendance record of the patients.

Assessment & Outcome Variables: Berg balance was used to assess the balance of the patients, while spatiotemporal measurements were used to assess the gait parameters. The Timed Up and Go test was utilized to evaluate functional mobility. This test measured the amount of time required to return to a sitting posture after standing up from a chair, walking a short distance, and returning to the chair. The assessment was made on baseline, 4^{th} week and 8^{th} week of study.

Data Analysis: Microsoft Excel was used for sorting and storage of data. SPSS V 27.0 was used for statistical data analysis. The validity of the findings was endured by adjusting the confounding variables.

3. Results

Demographic Distribution of patients: During the current study, we had 28 total patients with cerebral palsy. Out of 28, 15 patients were male (Figure 1). Upon comparison of demographic features, there was no significant difference in the age distribution between the treatment and control groups (10.3 ± 1.6 years vs. 11.2 ± 2.1 years, p = 0.59). This provides more evidence that the two groups' age distributions were comparable prior to the intervention. Different types of cerebral palsy were not significantly different between the two sets of patients. Among the two groups, 71.4% of the treatment group and 85.8% of the control group were categorized as spastic, dyskinetic, or ataxic, respectively (p = 0.68). (Table 1).

Variable	Treatment Group	Control Group	P Value
Age	10.3 ± 1.6	11.2 ± 2.1	0.59
Cerebral Palsy Type			
Ataxic	1 (7.1%)	0 (0%)	0.68
Dyskinetic	3 (21.4%)	2 (14.2%)	
Spastic	10 (71.4%)	12 (85.8%)	

Table 1: Demographic Characteristics of the patients

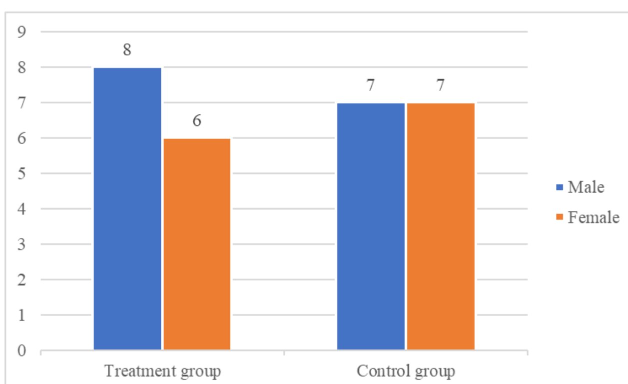

Figure 1: Demographic Characteristics of the patients

Berg Balance Score: The Berg Balance Score indicated a significant improvement in balance of treatment group receiving treadmill trainings with VF+RAC (P<0.05) (Table 2).

	Variable	Pre-treatment	Post-treatment	P Value
Berg Balance Score	**Treatment Group**	24.6 ± 3.1	27.4 ± 2.6	0.012
	Control Group	26.3 ± 4.2	27.2 3.0	0.23

Table 2: Berg Balance score for stability

According to Table 2, The Berg Balance Score is increased from 24.6 to 27.4, with a P value of 0.012, indicating a substantial improvement in balance during the treadmill training with VF+RAC in the treatment group. This implies that improving balance was a successful outcome of the intervention. With a P value of 0.23, the control group, in comparison, only displayed a modest, non-significant increase in balance. As a result, training with VF+RAC turned out to be more successful than training under control.

Spatiotemporal Gait Parameters: For spatiotemporal parameters, we measured the walking speed, stride length and gait stability of the patients in both groups. A significant improvement (p=0.0.23) was observed in patients receiving treadmill training with VF+RAC (Table 3).

Variable	Walking Speed (m/s)	Stride length in cm	Gait Stability	P Value
Treatment Group	0.71 ± 0.01	73.4 ± 2.6	81.2 ± 3.6	0.023
Control Group	0.65 ± 0.002	68.4 ± 3.2	77.5 ± 4.1	0.051

Table 3: Spatiotemporal gait characteristics in treatment and control group

According to Table 3, with the P value of 0.023, the spatiotemporal parameters showed that walking speed (0.71 m/s vs. 0.65 m/s), stride length (73.4 cm vs. 68.4 cm), and gait stability (81.2 vs. 77.5) were significantly improved in patients in the treatment group who received treadmill training with VF+RAC. This suggests that, in comparison to the control group, the treadmill training successfully improved certain gait characteristics. Even though the control group saw gains as well, P=0.051 indicates that the differences were not statistically significant. As a result, using VF+RAC during treadmill training produced more noticeable improvements in gait metrics.

Timed Up and Go (TUG) Test: For pre and post-test interventions, paired sample t test was used to check the statistically significant differences. A significant difference was observed in VF+RAC group (p<0.05) (Table 4).

	Variable	Pre-treatment (s)	Post-treatment (s)	P Value
TUG test	Treatment Group	26.6 ± 5.1	19.2 ± 3.7	0.024
	Control Group	24.3 ± 4.3	23.2 2.6	0.063

Table 4: Time Up and Go characteristics in treatment and control group

According to Table 4, The Time Up and Go (TUG) test results for the VF+RAC therapy group showed a significant improvement, with timings dropping from 26.6 seconds to 19.2 seconds (P=0.024), indicating improved mobility, according to the paired sample t-test results. By comparison, the control group experienced a slight variation from 24.3 seconds to 23.2 seconds (P=0.063), which was not statistically significant. This implies that, in comparison to the control conditions, the VF+RAC intervention greatly increased functional mobility.

4. Discussion

There is an increasing incidence of CP in children across the globe. Patients in underdeveloped countries are affected more and faces challenges in treatment due to limited facilities. Different studies have assessed the effect of exercises to reduce the symptoms of CP, and hence improve the lifestyle of patients. In patients with stroke, visual and auditory feedback were found to improve the spatiotemporal gait parameters (Shin, J et al.2022). A study on children affected by CP showed improvements in plantar flexor adaptation through auditory and visual feedback (Spomer, A. M et al.2023). CP can affect the long-term locomotor function in children (Hornby, T. G et al.2020).

The current study assessed the effect of treadmill training with VF+RAC on children with cerebral palsy. There was no significant difference in the age distribution between the treatment and control groups (10.3 ± 1.6 years vs. 11.2 ± 2.1 years, p = 0.59). The Berg Balance Score indicated a significant improvement in balance of treatment group receiving treadmill trainings with VF+RAC (P<0.05). For spatiotemporal parameters, we measured the walking speed, stride length and gait stability of the patients in both groups. A significant improvement (p=0.0.23) was observed in patients receiving treadmill training with VF+RAC. For pre and post-test interventions, paired sample t test was used to check the statistically significant differences.

Similar findings were observed in different studies. Sensory enhancements were found to be effective vestibular rehabilitation therapy. The gait and balance of the patients was improved after the auditory enhancements (Bao, T. et al 2020). A study evaluated the effectiveness of visual feedback on perceptual trainings (Wagner, A. R et al.2023). Another study on motor skill development showed significant impact of sensory signal in training interventions (Cancer, A. et al.2022).

To summarize, the study's findings indicate that children with cerebral palsy may benefit from visual feedback treadmill training. The children with spastic cerebral palsy benefit greatly from treadmill gait training combined with VF+RAC in terms of their ability to balance. The children with spastic cerebral palsy benefit greatly from treadmill gait training combined with VF+RAC in terms of increased gross motor function.

5. Conclusion

The study shows that children with cerebral palsy (CP) benefit greatly from treadmill training that combines visual feedback and rhythmic auditory cues (VF+RAC) to enhance balance and spatiotemporal gait characteristics. This shows that by utilizing several sensory pathways, the integration of visual and auditory signals into rehabilitation programs improves motor learning and coordination, ultimately leading to increased functional mobility and independence. These results show that VF+RAC has the potential to be a successful intervention for kids with CP, especially when it comes to improving gait stability and balance deficiencies, which are essential for day-to-day activities and quality of life.

But in evaluating the findings, one must take into account the limitations of the study. The eight-week duration of the intervention may have limited its ability to fully assess long-term improvement or the entire range of therapeutic advantages. The results cannot be applied to the greater CP population due to the small sample size, which emphasizes the necessity for bigger, more varied cohort studies in order to confirm the efficacy of VF+RAC. Subsequent research endeavors ought to concentrate on extended observation periods to ascertain the longevity of the noted enhancements and investigate the ideal frequency and length of training sessions to accomplish enduring advantages.

studying the processes via which VF+RAC improves motor function may also offer important new information for improving this strategy for improved clinical results. More focused and customized therapies for kids with cerebral palsy may result from our growing understanding of how sensory signals support motor learning. The study offers a solid basis for using VF+RAC in clinical practice, notwithstanding its limitations. As an adjunct to conventional rehabilitation techniques, physical therapists ought to take into account this multisensory approach, which has the potential to improve therapy outcomes and the quality of life for kids with cerebral palsy. Physical therapists are anticipated to apply this training strategy in clinical settings.

References

Aravamuthan BR, Fehlings D, Shetty S, Fahey M, Gilbert L, Tilton A, et al. Variability in cerebral palsy diagnosis. Pediatrics (2021). 147(2). https://publications.aap.org/pediatrics/article-abstract/147/2/e2020010066/77044

Bao, T., Klatt, B. N., Carender, W. J., Kinnaird, C., Alsubaie, S., Whitney, S. L., & Sienko, K. H. (2020). Effects of long-term vestibular rehabilitation therapy with vibrotactile sensory augmentation for people with unilateral vestibular disorders-A randomized preliminary study. *Journal of Vestibular Research: Equilibrium and Orientation*, *29*(6), 323–334. https://doi.org/10.3233/VES-190683

Cancer, A., de Salvatore, M., Granocchio, E., Andreoli, L., Antonietti, A., & Sarti, D. (2022). The Role of Auditory and Visual Components in Reading Training: No Additional Effect of Synchronized Visual Cue in a Rhythm-Based Intervention for Dyslexia. *Applied Sciences (Switzerland)*, *12*(7). https://doi.org/10.3390/app12073360

CP An Overview. (n.d.).

Gururaj, A. K., Sztriha, L., Bener, A., Dawodu, A., & Eapen, V. (2003). Epilepsy in children with cerebral palsy. *Seizure*, *12*(2), 110–114. https://doi.org/10.1016/s1059131102002558

Han, Y. G., & Yun, C. K. (2020). Effectiveness of treadmill training on gait function in children with cerebral palsy: Meta-analysis. In *Journal of Exercise Rehabilitation* (Vol. 16, Issue 1, pp. 10–19). Korean Society of Exercise Rehabilitation. https://doi.org/10.12965/jer.1938748.374

Hornby, T. G., Reisman, D. S., Ward, I. G., Scheets, P. L., Miller, A., Haddad, D., Fox, E. J., Fritz, N. E., Hawkins, K., Henderson, C. E., Hendron, K. L., Holleran, C. L., Lynskey, J. E., & Walter, A. (2020). Clinical Practice Guideline to Improve Locomotor Function Following Chronic Stroke, Incomplete Spinal Cord Injury, and Brain Injury. In *Journal of Neurologic Physical Therapy* (Vol. 44, Issue 1, pp. 49–100). Lippincott Williams and Wilkins. https://doi.org/10.1097/NPT.0000000000000303

Hunziker, S., Morosoli, F., Zuercher, K., Tscherter, A., & Grunt, S. (2023). Prescription Practices of Cannabinoids in Children with Cerebral Palsy Worldwide—A Survey of the Swiss Cerebral Palsy Registry. *Children*, *10*(12). https://doi.org/10.3390/children10121838

Jiang ZD, Wang C, Ping LL, Yin R (2023). Altered maturation in brainstem neural conduction in very premature babies with fetal growth restriction. Pediatr Res.;1–8.

Krägeloh-Mann, I., & Cans, C. (2009). Cerebral palsy update. In *Brain and Development* (Vol. 31, Issue 7, pp. 537–544). https://doi.org/10.1016/j.braindev.2009.03.009

Montero-Mendoza, S., & Calvo-Muñoz, I. (2019). Analysis of relationship among the functional classification systems in cerebral palsy and the different types according to the Surveillance of Cerebral Palsy in Europe. *Pediatric Dimensions*, *4*(1). https://doi.org/10.15761/pd.1000181

Morgan, C., Fetters, L., Adde, L., Badawi, N., Bancale, A., Boyd, R. N., Chorna, O., Cioni, G., Damiano, D. L., Darrah, J., de Vries, L. S., Dusing, S., Einspieler, C., Eliasson, A. C., Ferriero, D., Fehlings, D., Forssberg, H., Gordon, A. M., Greaves, S., … Novak, I. (2021). Early Intervention for Children Aged 0 to 2 Years with or at High Risk of Cerebral Palsy: International Clinical Practice Guideline Based on Systematic Reviews. In *JAMA Pediatrics* (Vol. 175, Issue 8, pp. 846–858). American Medical Association. https://doi.org/10.1001/jamapediatrics.2021.0878

Novak, I., Morgan, C., Adde, L., Blackman, J., Boyd, R. N., Brunstrom-Hernandez, J., Cioni, G., Damiano, D., Darrah, J., Eliasson, A. C., de Vries, L. S., Einspieler, C., Fahey, M., Fehlings, D., Ferriero, D. M., Fetters, L., Fiori, S., Forssberg, H., Gordon, A. M., … Badawi, N. (2017). Early, accurate diagnosis and early intervention in cerebral palsy: Advances in diagnosis and treatment. In *JAMA Pediatrics* (Vol. 171, Issue 9, pp. 897–907). American Medical Association. https://doi.org/10.1001/jamapediatrics.2017.1689

Nelson, K. B., & Leviton, A. (1991). How much of neonatal encephalopathy is due to birth asphyxia?. *American journal of diseases of children (1960)*, *145*(11), 1325–1331. https://doi.org/10.1001/archpedi.1991.02160110117034

Petrini, M. (2023). *THE EFFECT OF TREADMILL TRAINING VS. STANDARD PHYSICAL THERAPY ON GAIT IN INDIVIDUALS WITH MILD-MODERATE CEREBRAL PALSY: A META-ANALYSIS*.

Sankar, C., & Mundkur, N. (2005). Cerebral palsy-definition, classification, etiology and early diagnosis. *Indian journal of pediatrics*, *72*(10), 865–868. https://doi.org/10.1007/BF02731117

Spomer, A. M., Conner, B. C., Schwartz, M. H., Lerner, Z. F., & Steele, K. M. (2023). Audiovisual biofeedback amplifies plantarflexor adaptation during walking among children with cerebral palsy. *Journal of NeuroEngineering and Rehabilitation*, *20*(1). https://doi.org/10.1186/s12984-023-01279-5

Shin, J., & Chung, Y. (2022). The effects of treadmill training with visual feedback and rhythmic auditory cue on gait and balance in chronic stroke patients: A randomized controlled trial. *NeuroRehabilitation*, *51*(3), 443–453. https://doi.org/10.3233/NRE-220099

Swanson SS. Association Between Childhood Obesity and Cerebral Palsy, Down Syndrome and Epilepsy or Seizure Disorder (2023). Walden University; 2023 [cited 2023 Dec 30]. Available from: https://search.proquest.com/openview/b07b1550c6f2b84b5d7463c36089eb1b/1?pq-origsite=gscholar&cbl=18750&diss=y

Vitrikas, K., Dalton, H., & Breish, D. (2020). Cerebral Palsy: An Overview. *American family physician*, *101*(4), 213–220.

Wagner, A. R., & Merfeld, D. M. (2023). Influence of Visual Feedback on Roll Tilt Perceptual Training. *Otology & neurotology: official publication of the American Otological Society, American Neurotology Society [and] European Academy of Otology and Neurotology*, *44*(9), 949–955. https://doi.org/10.1097/MAO.0000000000003990

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Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: The current study was approved by institutional review board (IRB). Trial was registered in ClinicalTrials.gov PRS; ID: NCT05787977

Appendix and Data Availability: Participants privacy is governed by ethical norms and confidentiality agreements, the data supporting the study's findings are not publicly available. The raw data cannot be shared as a result. However, the publication clearly outlines the approach, analysis and findings of the study. For additional questions, please get in touch with the relevant author; email: asmabashir.pt@gmail.com

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