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Effect of rhythmic auditory stimulation on cadence and gait speed in spastic cerebral palsy

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ABSTRACT

The purpose of this research was to assess whether any improvement is seen in Cadence and Gait speed by giving Gait training with Rhythmic Auditory Stimulation (RAS) along with general mobility strengthening exercises in spastic cerebral palsy (CP). It is seen that spastic CP have impaired internal cueing, co-contraction of agonist with antagonist instead of normal reciprocal relaxation persists, the chain of muscles used for movements have abnormal firing & abnormal gait pattern with affected gait parameters such as reduced cadence and gait speed, reduced step and stride length, and RAS has an effect on improving the internal cueing which may in turn help improve the affected gait parameters. In this study 31 subjects were selected all of them were given conventional physiotherapy exercises & gait training for 20 minutes individually; 16 were given gait training with RAS(experimental) & 15 were given conventional gait training without RAS(conventional). It was seen that the experimental group had a much more efficient and significant improvement in cadence & gait speed as compared to the conventional group, suggestive of RAS providing an efficient added effect over conventional physiotherapy exercises in spastic CP.

Keywords: Gait parameters, Cadence, Gait speed, Rhythmic Auditory Stimulation (RAS), Spastic cerebral palsy.

INTRODUCTION

Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. [1]

Spasticity accounts for approximately 80% of all paediatric CP presentations and of these children, 70% will achieve some form of ambulation and hence, most of the research on gait focuses on children who present predominantly with spasticity. [2]

Spastic CP shows the feature of spasticity, that is, a disorder of tone characterized by an initial increased resistance to stretch which may then lessen abruptly. Spastic muscles are observed to be continuously contracting, and also there is apparent weakness of their antagonists seen in spastic CP leading to abnormal positions of the joints that the groups of muscles are acting on. Deformities of joints developed may become fixed contractures later on. Abnormal postures associated with antigravity muscles are seen. [3] The muscles are found to be structurally normal but abnormally extensible in early development. [7] The group or chain of muscles used may be same or different from those used in normal children of the same age. The muscles which work in association with each other can be normal or abnormal. Co-contraction of agonist with antagonist instead of normal reciprocal relaxation persists in spastic CP. [4] Voluntary movements are directly affected as poor postural control interferes with their efficiency creating weakness of both postural muscles and movement patterns. [4] Co-contraction of a positive supporting response is seen before postural control develops and in early stages of walking, in normal infants, which persists in spastic CP. [8] Spastic CP children begin to walk much later & much more slowly as compared to normal children of the same age group. [5, 12] They also have reduced stride length & step width. While changing gait speed, spastic CP children differ cadence rather than stride length like normal children do, may be due to static or dynamic contractures that limit motion. [5, 18] When doing daily activities, example being walking, these children have higher heart rate and oxygen rates than children with no known neuromuscular impairments, which means that the energy expenditure would be more than normal children, which may be because of flexed posture, which requires additional muscle activity for stability. [5] The older the child gets, the oxygen rates associated with any activity increases with increase in body weight and size, and hence the energy expenditure associated with daily activities increases. Activities of daily living and mobility tasks are difficult due to neuromuscular impairments affecting their ability to generate and time the forces needed for these activities. [5]

Spastic CP commonly occurs in these forms [9]

a. Spastic Hemiplegia / Unilateral CP
b. Spastic Diplegia/ Bilateral Spastic CP
c. Spastic Quadriplegia/ Quadriparesis.

Abnormal gait seen in spastic CP is due to CNS problems which affect the organization and execution of movement patterns related to posture and gait. [5, 10] No two individuals with CP have the same gait pattern. [5] Effect of motor impairments on gait are seen as neuromuscular and musculoskeletal impairments. Musculoskeletal problems develop secondarily to primary neuromuscular problems. Neuromuscular control of gait includes generation of basic locomotor patterns for progression, the control of posture & stability & the adaptation of gait patterns with the change in needs. Spasticity is the main neuromuscular impairment causing inappropriate activation of a muscle at points during the gait cycle when it is being rapidly lengthened. Spasticity also produces increased stiffness, a musculoskeletal problem. Increased stiffness causes difficulty in movements of body segments freely which limits the transfer of momentum during gait, affecting the progression requirements of locomotion & also affect the ability of muscles to generate power at various speeds. [5, 11, 13]

The most common gait pattern seen in spastic diplegic CP is crouched gait pattern as a result of excessive hip & knee flexion, in conjunction with excessive plantarflexion, and anterior pelvic tilt during the stance and swing phases of gait. [14] And in spastic hemiplegic CP it is common to see Genu Recurvatum gait pattern characterized by knee hyperextension during stance & excessive ankle plantarflexion. Hip flexion and forward lean of the trunk may occur as the patient leans forward to balance over a plantarflexed foot.

Common problems in gait for those with spastic CP include ineffective gait patterns, such as short stride length; asymmetrical gait, slowness, impairment in coordination, and unnecessary body movement. [15]

RAS has been found to be effective in an adjunctive role or as a sole method to increase the effectiveness of traditional physical therapy for ambulation in adult rehabilitation settings such as Stroke and Parkinson’s disease. In a study done by Dr. M.H.Thaut et al. on RAS in Gait training for Parkinson’s disease patients, the subjects showed significant improvement in gait velocity, stride length and step cadence. [23] In a similar study by G.C.McIntosh et al. on Rhythmic Auditory Motor Facilitation of Gait patterns in patients with Parkinson’s disease showed that the improvements seen in the gait velocity, cadence and stride length were consistent and prolonged. [24]

Similarly in Stroke patients, in a study by Rebecca Hayden et al. on effect of RAS on physical therapy outcomes for patients in Gait training following Stroke: a Feasibility study, showed feasible results to use RAS to enhance Gait training in the patients following Stroke. [25] A study by Sun Lee Hyun et al. on The effect of RAS on Gait and Balance in Hemiplegic Stroke patients, proved RAS as an effective method to improve gait velocity, cadence, stride length and standing balance in Hemiplegic Stroke patients. [26] Yuri Cha et al. also did a similar study on Immediate effect of RAS with Tempo changes on Gait in Stroke patients, which showed that faster RAS tempo increased gait velocity, cadence, balance and stability in those patients, with 20% increase in tempo showing the best results. [27]

CP patients encounter difficulties with coordination and muscle control similar to those experienced by rehabilitation patients in hemiplegia & parkinson's disease, which suggests that RAS may be beneficial if used to enhance traditional physical therapy treatments. [15] In a study done by Eunmi Emily Kwak on Effect of RAS on Gait Performance in children with Spastic CP, showed that RAS does influence and improve gait performance in children with spastic CP. [15]

Rhythmic Auditory Stimulation (RAS) is a neurologic technique using the physiological effects of auditory rhythm on the motor system to improve the control of movement in rehabilitation and therapy. [15] Key element of RAS is the phenomenon of auditory entrainment, that is, the body's ability to synchronize its movements rhythmically. [15] The effect of rhythm on outward physical movement has long been evident, but recent research has revealed the role of auditory stimulation as an internalized timekeeper for rhythmic patterned movements. [15, 16]

The gait patterns of individuals with cerebral palsy are influenced primarily by weakness, abnormalities in muscle tone & synergistic organization, diminished influence of righting and balance reactions, dissociation among body parts, and incoordination. [17] In spastic gait, a loss of control over the sequential timing of muscular activity may result in asymmetrical step and stride lengths, and deviations such as forward or backward trunk leaning, excessive or decreased hip or knee flexion, or altered dorsiflexion or plantarflexion, may occur. [17] Most gait training and rehabilitation protocols work on strengthening of the muscles involved for gait function and practicing the gait pattern, whereas RAS works on the sequential timing of movement and co-ordination. The purpose of this research is to use rhythmic auditory stimulation (RAS) for children with spastic cerebral palsy (CP) to determine functional outcome effectiveness on cadence and gait speed for ambulation. RAS uses music as an external time cue to regulate body movement. There have been studies about gait training showing effectiveness and testing being done by gait analysis and has shown results on. But there hasn't been enough research on the added effect of Gait training with Rhythmic Auditory Stimulation (RAS) or Music Therapy along with general mobility and strengthening exercises on increase of cadence in spastic CP in a clinical setting, hence this study was undertaken.

MATERIALS & METHODS

- Type of Study: Experimental
- Study Duration: 5 weeks; 3 days a week.
- Study Setting: secondary health center, special schools.
- Sample Design: Purposive random Sampling
- Sample Size: 31; 16 in experimental and 15 in control group.
- Materials: Pen, Paper, chalk, tape measure, 2 cones, Stop Watch, Metronome.
- Outcome Measures:

1. Cadence(no. of steps/minute)
2. Time taken for ambulation of 10metre walk test in seconds (for gait speed).

Inclusion criteria

- Children with Spastic Cerebral Palsy within the age group of 6-18 years of age.
- Ambulatory Spastic CP children with GMFCS scores levels I, II & III with or without orthosis.

Exclusion criteria

- Athetoid, Ataxic, Mixed and Dystonic Cerebral Palsy.
- Any fractures of the lower limbs.
- Any recent surgeries of the lower limbs.
- Botox injections given at any point of time.

Procedure

All the subjects were screened for inclusion and exclusion criteria. Sample size of 31 subjects was selected for 5 weeks protocol. A written consent was taken from the parents or guardians and Informed Assent was taken from the children.

At 0 week

Pre-treatment assessment was done for cadence and gait speed which were checked individually. Cadence was checked by counting no. of steps walked per minute on level ground. Gait speed was measured by time taken for ambulation of 10metre walk test (10MWT). The area taken for 10MWT was a 14metre hallway with 2metre distance at the start and the end for acceleration and deceleration resp. The 31 subjects were randomly distributed into two groups of 15 & 16 control groups and experimental group respectively were taken for the study. Both the groups were assessed for 1RM. Re-evaluation for 1RM was done every week and progression was done accordingly.

0-5 weeks

One group received Rhythmic Auditory Stimulation by Metronome by Metronome beats given with the help of an application Pro Metronome by EUMLab-Xanin Technology GmbH and played out by a Bluetooth loudspeaker, for Gait training along with conventional mobility and strengthening exercises for spastic CP (Experimental Group) and the beats were set according to the cadence of the individual. Commando beats were used for the study. The Other group received Conventional Gait training with conventional mobility and strengthening exercises for spastic CP. (Control Group). Each child was given Gait training individually for 20 minutes. And the individuals were given a rest interval between the gait training period if needed, and the total time excluding the rest intervals was taken for 20 minutes.

In the experimental group RAS was given for gait training Progression for the metronome beats was made by 5% every week and adjusted according to the individual's cadence. If the cadence fell below 65steps/minute, the metronome beats were doubled and the child was told to take a step on every second beat. The gait training was therapist guided throughout. The area taken for gait training was a free open space with level ground for both, the control and experimental group.

The mobility exercises included were: Quadriceps, Hamstrings and Tendoachilles muscle stretching; and Active exercises for bilateral lower limbs.

The strengthening exercises included were: Quadriceps, Hamstrings, Hip Abductors and Glutei strengthening with free ankle weights, heel raises, half squats, sit-to-stand and step-up exercises.

- Core muscles' strengthening was also done.
- Any changes would be noted in both the groups.

At 5 weeks

Post intervention Cadence (no. of steps/minute) and Gait speed (time taken in seconds) to complete 10-metre walk test was done for assessment.

Gait training with RAS was stopped at 5 weeks post intervention and regular physiotherapy for both the groups was continued thereafter. The subjects were still continued to check for outcome measures at 2 weeks and 4 weeks post RAS gait training intervention to check for lingering effects of the RAS intervention.

At 7 weeks

At 2 weeks post intervention Cadence (no. of steps/minute) and Gait speed (time taken in seconds) by 10-metre walk test was done for assessment.

At 9 weeks

At 4 weeks post intervention Cadence (no. of steps/minute) and Gait speed (time taken in seconds) by 10-metre walk test was done for assessment.

Table No.1: Procedure

	INTERVENTION		CONTROL	EXPERIMENTAL
0 WEEK	Outcome measures	Cadence(no.of steps/minute)	✓	✓
		10MWT (time taken-in seconds)	✓	✓
0-5 WEEKS 3days/week for 5 weeks	20 minutes Gait training		Conventional	Rhythmic Auditory Stimulation (RAS)

	Conventional Physiotherapy Exercises (Mobility and strengthening exercises)		✓	✓
5 WEEKS	Outcome measures	Cadence(no.of steps/minute)	✓	✓
		10MWT (time taken-in seconds)	✓	✓
7 WEEKS	Outcome measures	Cadence(no.of steps/minute)	✓	✓
		10MWT (time taken-in seconds)	✓	✓
9 WEEKS	Outcome measures	Cadence(no.of steps/minute)	✓	✓
		10MWT (time taken-in seconds)	✓	✓

RESULTS & DISCUSSION

Results

Table no.2: Demographic Data

Population Type	No. of subjects	No. of Males	No. of Females
ALL	31	25	6
Spastic Diplegic	24	21	3
Spastic Quadriplegic	2	1	1
Spastic Quadriparesis	2	0	2
Spastic Hemiplegic	3	3	0

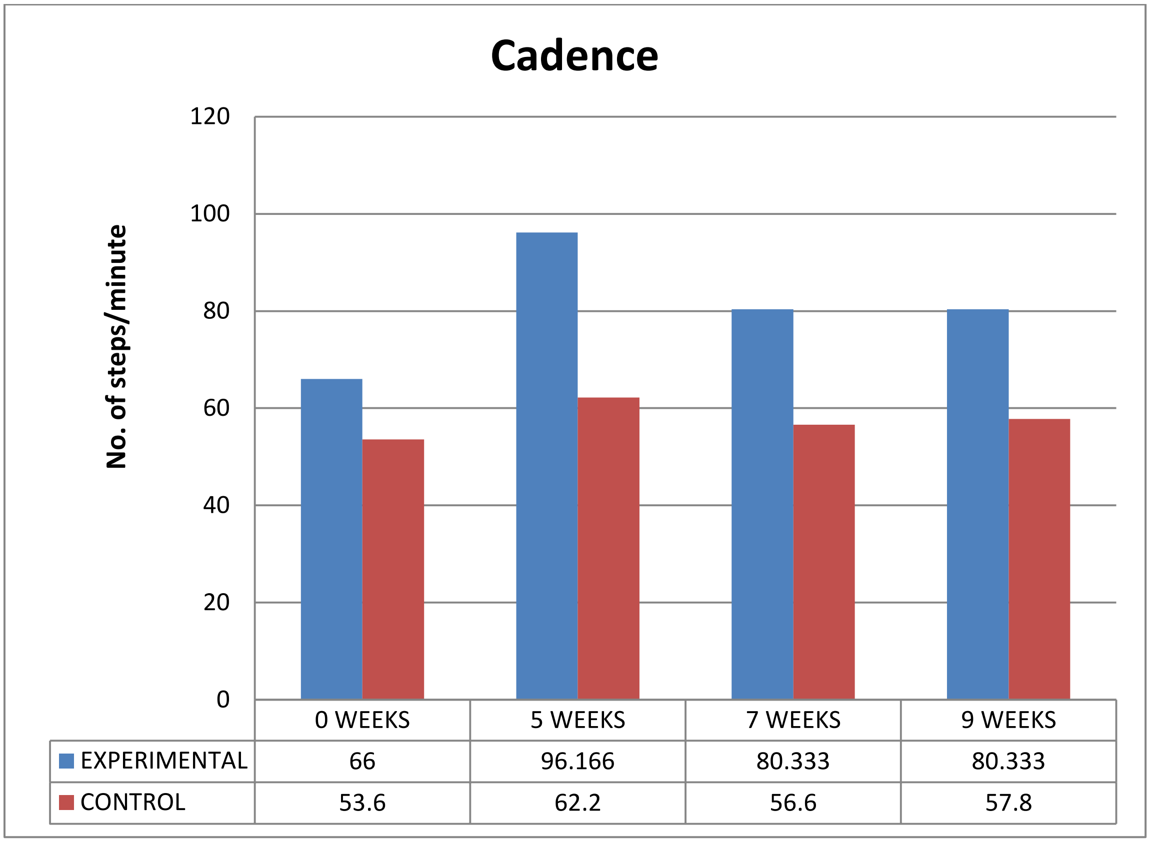
Table no. 3: According to Assistive Devices used

Assistive devices	No. of subjects	No. of Males	No. of Females
ALL	31	25	6
Non Assistive devices	14	13	1
Elbow crutches	6	6	0
Walker	11	6	5

The Pre & Post Intervention, 2weeks and 4 weeks later scores of Cadence and 10metre walk test were compared using **Repeated Measures of Analysis of Variance (Repeated ANOVA).**

The mean difference between values obtained pre intervention and assessment at different intervals (5 weeks, 7 weeks, 9 weeks) was compared statistically using unpaired t test for cadence as well as gait speed.

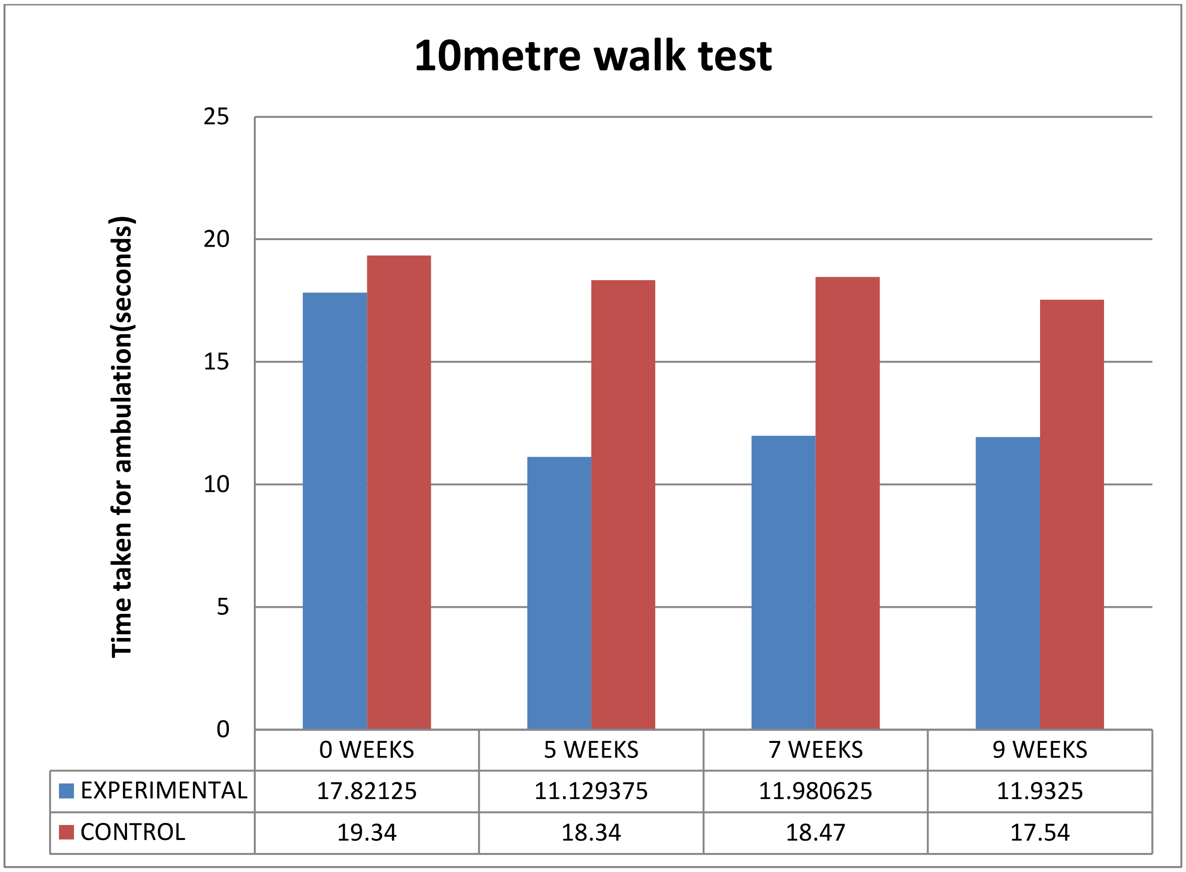
For comparisons within the group for both experimental and control **Paired t-test (two-tailed)** was used. The group readings are named as $\mathbf{E_0}$ $\mathbf{E_5}$ $\mathbf{E_7}$ $\mathbf{E_9}$ for the experimental group at weeks 0, 5, 7, 9 respectively and $\mathbf{C_0}$ $\mathbf{C_5}$ $\mathbf{C_7}$ $\mathbf{C_9}$ for the control group at weeks 0, 5, 7, 9 respectively.



Graph 1: Cadence over 0-9 weeks

This graph shows that in the Control group the no. of steps taken per minute showed slight increase immediately post intervention(at 5 weeks) as compared to pre intervention values but showed decrease again at 2 weeks and 4 weeks post intervention(7 weeks and 9 weeks resp.) Cadence in the control group was statistically not significant immediately post intervention, with p value lesser than 0.3890, 2weeks post intervention p value=0.5074 which is not significant & 4weeks post intervention p value=0.7672 which is also not significant. Whereas in the Experimental group the no. of steps taken per minute showed significant increase immediately post intervention(at 5 weeks) as compared to pre intervention values but showed slight decrease again at 2 weeks and 4 weeks post intervention(7 weeks and 9 weeks resp.) But the values were still significantly greater than the pre intervention values. Improvement in cadence in the experimental group which was statistically extremely significant immediately post intervention, with p value lesser than 0.0001, 2weeks post intervention p value=0.0564 which is not quite significant & 4weeks post intervention p value=0.1373 which is also not quite significant.

When the control and experimental group were compared, the mean differences for cadence were extremely significant immediately post intervention with p value lesser than 0.0001, not significant in 2 weeks & 4 weeks post intervention with p value 0.1798 & 0.1511 resp.



Graph 2: Gait speed over 0-9 weeks

This graph shows that in the Control group the time taken for 10MWT showed slight decrease immediately post intervention(at 5 weeks) as compared to pre intervention values and again showed slight decrease at 2 weeks and 4 weeks post intervention(7 weeks and 9 weeks resp.) For gait speed in the control group, the results were not significant immediately post-intervention, 2 weeks post intervention and 4 weeks post intervention with p value being 0.2343, 0.2047, 0.0382 respectively.

Whereas in the Experimental group the time taken for 10MWT showed significant decrease immediately post intervention (at 5 weeks) as compared to pre intervention values and were almost constant at 2 weeks and 4 weeks post intervention (7 weeks and 9 weeks resp.) as that of the values immediately post intervention but the time taken was still significantly lesser than the pre intervention values. For gait speed in the experimental group, the results were extremely significant immediately post-intervention, 2 weeks post intervention and 4 weeks post intervention with p value being 0.0003, 0.0006 & 0.0006 respectively.

When the control and experimental group were compared, the mean differences for gait speed were very significant immediately post intervention and 2 weeks post intervention with p value 0.0021& 0.0032 resp. and 4 weeks later the mean difference were still significant with p value 0.0161.

Table No.4: Statistical Tests for Cadence

Group	Statistical Test used	Comparison between		p value	Significance
Control	1.Paired t-test	i.	C_0-C_5	0.2343	not Significant
		ii.	C_0-C_7	0.2047	not Significant

		iii.	C_0-C_9	0.0382	not Significant
	2.Repeated ANOVA		C_0,C_5,C_7,C_9	0.4673	not Significant
Experimental	1. Paired t-test	i.	E_0-E_5	<0.0001	Extremely Significant
		ii.	E_0-E_7	0.0564	not quite Significant
		iii.	E_0-E_9	0.1373	not quite Significant
	2.Repeated ANOVA		E_0,E_5,E_7, E_9	<0.0001	Extremely Significant
Control v/s Experimental	1.Unpaired t-test	i.	C_0-C_5 v/s E_0-E_5	<0.0001	Extremely Significant
		ii.	C_0-C_7 v/s E_0-E_7	0.1798	not Significant
		iii.	C_0-C_9 v/s E_0-E_9	0.1511	not Significant

Table no.5: Statistical Tests for 10metre Walk Test

Group	**Statistical Test used**	**Comparison between**		**p value**	**Significance**
Control	1.Paired t-test	i.	C_0-C_5	0.2343	not Significant
		ii.	C_0-C_7	0.2047	not Significant
		iii.	C_0-C_9	0.0382	not Significant
	2.Repeated ANOVA		C_0,C_5,C_7,C_9	0.0506	not Significant
Experimental	1. Paired t-test	i.	E_0-E_5	0.0003	Extremely Significant
		ii.	E_0-E_7	0.0006	Extremely Significant
		iii.	E_0-E_9	0.0006	Extremely Significant
	2.Repeated ANOVA		E_0,E_5,E_7, E_9	<0.0001	Extremely Significant
Control v/s Experimental	1.Unpaired t-test	i.	C_0-C_5 v/s E_0-E_5	0.0021	Very Significant
		ii.	C_0-C_7 v/s E_0-E_7	0.0032	Very Significant
		iii.	C_0-C_9 v/s E_0-E_9	0.0161	Significant

DISCUSSION

This study was undertaken to check whether there occurs an improvement in cadence and gait speed after intervening with Gait training via Rhythmic auditory stimulation along with conventional physiotherapy exercises.

From the results in this study, it was seen from graph no.1 in the Experimental group the no. of steps taken per minute showed significant increase immediately post intervention (at 5 weeks) which was extremely significant statistically as compared to pre intervention values (with p value lesser than 0.0001) and when checked again at 2 weeks post intervention(at 7 weeks p value=0.0564) were still quite significant clinically and 4 weeks post intervention(at 9 weeks p value=0.1373) were still significantly greater than the pre intervention values clinically.

Whereas for Cadence over 0 to 9weeks that in the Control group the no. of steps taken per minute showed slight increase immediately post intervention (at 5 weeks p value= 0.3890) as compared to pre intervention values but showed decrease again at 2 weeks (p value=0.5074) and 4 weeks post intervention (p value=0.7672) (7 weeks and 9 weeks resp.) The changes in Cadence in the control group were statistically not significant at any time, immediately post intervention, 2weeks post intervention & 4weeks post intervention.

When the control and experimental group were compared, the mean differences for cadence were extremely significant immediately post intervention (p value lesser than 0.0001), not significant in 2 weeks (p value=0.1798) & 4 weeks (p value=0.1511) post intervention, but clinically the cadence was till greater than pre assessment values. This proves that the effect of RAS on cadence was seen with improvement in the number of steps taken per minute.

The factor behind this maybe that in cerebral palsy, in spastic gait, a loss of control over the sequential timing of muscular activity may result in reduced cadence, asymmetrical step and stride lengths, reduced cadence and gait speed which is due to absence of internal cueing for movements in the individual and RAS has been found to improve the internal cueing resulting in improving the above mentioned parameters, wherein in studies on Parkinson's disease and Hemiplegia have been done. [23, 24, 25, 26, 27, 28] RAS guides the patients to hit the ground with their feet as they walk and simultaneously hear an external auditory cue, synchronizing the time of contact between the foot and ground with the sound hence may help in improving cadence. [27]

The graph no.2 for 10metre walk test (10MWT) over 0 to 9 weeks, shows that in the Experimental group the time taken for ambulating 10MWT showed significant decrease immediately post intervention(at 5 weeks, p value=0.0003) as compared to pre intervention values and were almost constant as that of immediately post intervention again at 2 weeks (p value=0.0006) and 4 weeks post intervention (p value=0.0006) (7 weeks and 9 weeks resp.) as that of the values immediately post intervention, but the time taken was still significantly lesser than the pre intervention values. For gait speed in the experimental group, the results were statistically extremely significant immediately post-intervention, 2 weeks post intervention and 4 weeks post intervention, that is at all 3 points of time. Clinically also the improvements seen were very significant and sustained. This proved that the effect of RAS on gait speed was also seen with reduced amount of time taken for ambulation for 10MWT.

In the Control group the time taken for 10MWT showed slight decrease immediately post intervention (at 5 weeks p value=0.2343) as compared to pre intervention values and again showed slight decrease at 2 weeks (p value=0.2047) and 4 weeks (p value=0.0382) post intervention (7 weeks and 9 weeks resp.) but was not significant statistically at any point of time.

When the control and experimental group were compared, the mean differences for gait speed were statistically very significant immediately post intervention (p value=0.0021) and 2 weeks post intervention (p value=0.0032) and 4 weeks later (p value=0.0161) the mean difference were still significant statistically.

Thaut et al. (2009) studied the effects of different RAS speeds (3%, 7%, 20%) on tapping in healthy adults and reported that both sides of the frontal lobe and occipital lobe showed increased neuronal population activation as the speed increased, and that the increased activity in the occipital lobe also included synchronized rhythm patterns when the rhythm was increased 20%, suggestive of the mechanism because of which the gait speed and cadence was improved. [27] RAS is helps to improve movement patterns by activating the internal timekeeping mechanism, leading to synchronization of the movement. [27] When the gait pattern of a person with CP is not rhythmic, it is likely that the internal timekeeper is not working. In these types of situations, RAS has been used to help regulate the motor control system by stimulating lower-level brain functions of the basal ganglia, cerebellum, brain stem, and spinal cord for patients with Cerebral palsy and other neuromuscular disease diseases. [15] RAS can increase the excitability of spinal motor neurons via the reticulospinal pathway, reducing the time needed for the muscle to respond to a motor command. RAS was proved to have an effect by inducing synchronization of movement and rhythm through sensory stimulation. By applying RAS, a movement can be synchronized to the beat as the movement is actively repeated at the same rhythm, and as the person tries to synchronize their movement with the music, concentration and motor control are both promoted. [27]

According to previous researchers, rhythm is an essential element of motor movement including motor control and output, because rhythmic auditory cuing facilitates movement by providing a mechanism for planning movements. The key element of RAS is the phenomenon of auditory entrainment, that is, the body's ability to synchronize its movements rhythmically. External auditory activity is mediated by internal un-conscious perceptual shaping at the subcortical level, and can arouse and raise the excitability of spinal motor neurons mediated by auditory-motor circuitry at the reticulospinal level. [15, 19]

Rhythmic auditory stimulation (RAS) is one of the neurological therapeutic methods that has physiological effects in rehabilitative exercise therapy, which improves movement control by improving gait in terms of velocity, stride length, and cadence when applied to patients with cerebral palsy, stroke, and Parkinson's disease (various kinds of neurologic diseases) as a rehabilitation therapy. External stimuli promote the essential energy needed for movement through synchronized and integrated physical movement, and auditory stimulation can improve walking abilities by redefining gait patterns and motor control. [27] RAS is reported to improve movement patterns by activating the internal timekeeping mechanism, which leads to movement synchronization. [27] This helped proved that RAS does have a positive and added effect on conventional physiotherapy in spastic CP.

CONCLUSION

The purpose of this study was to assess whether Gait training with RAS along with general mobility and strengthening exercises has an effect on increase in cadence and gait speed in spastic cerebral palsy, and the improvement was seen both in Cadence, that is the total number of steps taken per minute were increased and Gait speed, that is the time taken for ambulation was decreased, both of which suggestively occurred due to RAS. So we conclude that RAS with gait training does have an added effect on conventional physiotherapy in spastic CP.

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