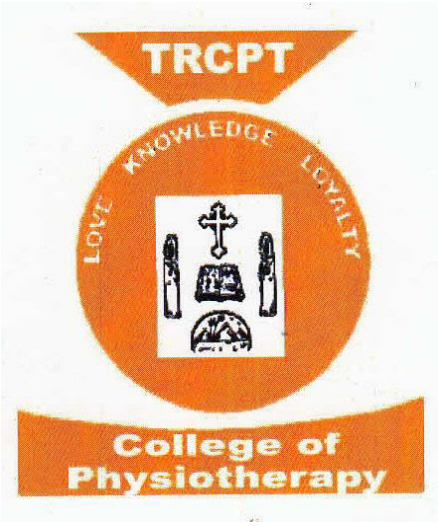
A STUDY TO ASSESS THE EFFECTIVENESS OF RHYTHMIC AUDITORY STIMULATION ALONG WITH NEURODEVELOPMENTAL THERAPY IN IMPROVING THE GAIT PATTERN OF POST STROKE PATIENTS



(Reg No: 271620142)

MPT-NEUROLOGY

Dissertation Submitted To

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY, CHENNAI

TOWARDS PARTIAL FULFILLMENT AS REQUIREMENT FOR THE DEGREE

MASTER OF PHYSIOTHERAPY

MAY 2018

A STUDY TO ASSESS THE EFFECTIVENESS OF RHYTHMIC AUDITORY STIMULATION ALONG WITH NEURODEVELOPMENTAL THERAPHY IN IMPROVING THE GAIT PATTERN OF POST STROKE PATIENTS

Internal Examiner:

External Examiner:

A dissertation submitted in partial fulfillment as a requirement for the degree

MASTER OF PHYSIOTHERAPY

To

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI

MAY 2018

CERTIFICATE

This is to certify that the research work entitled **"A STUDY TO ASSESS THE EFFECTIVENESS OF RHYTHMIC AUDITORY STIMULATION ALONG WITH NEURODEVELOPMENTAL THERAPHY IN IMPROVING THE GAIT PATTERN OF POST STROKE PATIENTS"** was carried out by the candidate with the **(REG NO: 271620142)** Master of physiotherapy student at Thanthai Roever Collage of Physiotherapy, Perambalur, submitted to Tamil Nadu Dr. M.G.R. Medical University, Chennai towards the partial fulfillment as a requirement for the Degree Master of Physiotherapy **(MPT- NEUROLOGY).**

Prof. C.V. John Franklin, MPT. MIAP.
Principal
Thanthai Roever College of Physiotherapy
Perambalur -621212

CERTIFICATE

This is to certify that the research work entitled **"A STUDY TO ASSESS THE EFFECTIVENESS OF RHYTHMIC AUDITORY STIMULTION ALONG WITH NEURODEVELOPMENTAL THERAPHY IN IMPROVING THE GAIT PATTERN OF POST STROKE PATIENTS"** was carried out by the candidate with the **(REG NO: 271620142)** Thanthai Roever College of Physiotherapy Perambalur under the guidance of me towards the partial fulfillment as a requirement for the degree Master of Physiotherapy Submitted to The Tamil Nadu Dr. MGR Medical University Chennai. **(MPT- NEUROLOGY).**

GUIDE

Prof. K. Krishnaraja, MPT., MIAP.,

Vice-Principal

Thanthai Roever College of Physiotherapy

Perambalur -621212

ACKNOWLEDGEMENT

First and foremost I wish to acknowledge my heartfelt gratitude to the **LORD ALMIGHTY** for his presence and guidance.

My warm-hearted thanks to the Thanthai Roever College of Physiotherapy, St. John Sangam Trust, especially to the Chairman **Dr. K. VARADHARAJAN, B.A., B.L.,** for giving me an opportunity to study in this Institution.

I am indebted to **Prof. C.V. John Franklin, MPT. MIAP**., Principal who spared his time and effort with his skilled knowledge, performance guidance and benevolence without which this research work would never have been finished.

I owe my sincere thanks to my Guide, **Prof. K. Krishnaraja, MPT., MIAP.,** Vice-Principal Thanthai Roever College of Physiotherapy for his advice and assistance at different stages of this study.

I pay my thanks to my Faculty Members and their support and guidance.

I pay my deep gratitude to my family members for their continuous support and encouragement in doing this project.

TABLE OF CONTENTS

INTRODUCTION

Gait restoration after stroke is a major concern of neurological rehabilitation. Stroke is the major cause of disability and raising mare number of handicaps in this industrialized world. In India thy rate of people affected by stroke is keep on increasing because of poor life style and other major factors. The need of rehabilitation after stroke places an important role to make the patient functionally independent in all aspect of basic life style. Physiotherapist is one of the team members who treat the patient in gross motor aspect.

In physiotherapy there are newly developed principles focusing, on task specific, repetitive and novel treatment approaches. Treadmill training with partial body weight supported, automated gait rehabilitation, functional electrical stimulation, rhythmic auditory cuing and botulinium toxin treatment of focal spasticity are some of current trends in physiotherapy practice to improve the functional level of neurologically challenged people. Balance and gait problem in, stroke is one of the common problems of all kind of patient. The improvement of gait ability of stroke patient in acute cases helps them to function in major ADL without others help. This also reduces their length of stay in Hospitals and also thus reduces the economic expenses of those patients. For chronic cases it is essential for them to safely ambulate at the level of community. For the patient who can able to walk at community level faces some problems in some situations like crossing roads, where traffic troubles them more and urges' them to take quick steps to avoid critical circumstances. So speed of gait is more essential to finish the task more specific. There are some studies done for such kind of patient using some technique to improve speed and pattern of gait.

In my project I aimed at to show the speed of recovery of gait pattern in hemiplegic patient following stroke using combination of two different techniques.

Its study to show the rate of recovery of gait pattern following the application of Rhythmic auditory stimulus technique along with NDT in post-stroke patient.

AIM AND OBJECTIVES

Statement of the study

A study to assess the efficacy of Rhythmic auditory stimulation Along with Neuro developmental treatment approach in improving the gait pattern of Post stroke patients.

Aim and need of the study

The aim of the study is to find the efficacy of combined treatment (Rhythmic auditory stimulation and Neuro Developmental Treatment approach) in improving the gait pattern of post stroke patient.

Many researches are -going on to improve the life expectancy and functional improvement of patients following stroke. Among which in rehabilitation gait is an important motor function which help them to ambulate the patient with minimal support at home and at community level. There are many upcoming treatment technique-like Treadmill training, Constraint induced movement therapy which showed a remarkable improvement in task specific training program, Rhythmic auditory stimulation is a recent approach developed by Thaut, Mcintosh and Rice where rhythmic auditory cues were used to enhance the motor performance of neurologically affected patient. There are many studies have been done previously in other neurological conditions like Parkinsons, Multiple sclerosis, Cerebral palsy to show the efficacy of this treatment program. In my project I aimed at to show, these auditory cues help the patient to enhance the motor function.

REVIEW OF LITERATURE

1. **Rhythmic Auditory Stimulation Improves Gait More Than NDT/Bobath, Training In Near-Ambulatory Patients Early Post Stroke: A Single-Blind, Randomized Trial**
   K. Leins, PhD, M. H. Thaut, PhD, R. R. Rice, MS, H. Argstatter, MA, G. P. Kenyon, MS, G. C. McIntosh, MD, H. V. Bolay, PhD, M. Fetter, MD.

   Conclusions: The data show that after 3 weeks of gait training, RAS is an effective therapeutic method to enhance gait training in hemi paretic stroke rehabilitation. Gains were significantly higher for RAS compared to NDT/ Bobath training

2. **A Home-Based Walking Program Using Rhythmic Auditory Stimulation Improves Gait Performance in Post stroke patients: A Pilot**
   Study Dwyer Conklyn, Darlene Stough, Eric Novak, MS, Sarah Paczak, Kamal Chemali, MD, Francois Bethoux, MD.

   Conclusions: These results in a convenience sample of MS patients demonstrate the feasibility and safety of RAS when used at home and suggest a potential benefit on gait parameters.

3. **Visual and kinesthetic locomotor imagery training integrated with auditory step rhythm for walking performance of patients with chronic stroke May 27, 2010**
   Jin-SeopKim, Duck-Won Oh, Suhn-Yeop Kim, Jong-Duk Choi

   Conclusions: The therapeutic effect may be further enhanced in the kinesthetic locomotor imagery training than in the visual locomotor imagery training. The auditory step rhythm together with the locomotor imagery training produces a greater positive effect in improving the walking performance of patients with post- stroke hemiparesis.

4. **Rehabilitation of Gait Speed After Stroke: A Critical Review of Intervention Approaches Ruth Dickstein, DSc**

   Simple "low technology" and conventional exercise to date is at least as efficacious as more complex strategies such as treadmill and robotic-based interventions.

5. **The Effectiveness of the Bobath Concept in Stroke Rehabilitation**

   BoudewijnJ. Kallen, PhD; Sheila Lennon, PhD; Bernadette Lyons, MSc, Laura Wheatley-Smith BSc; Mark Scheper, MSc; Jaap H. Buurke, PhD; Jos Halfens; Alexander C.H. Geurts, MD, PhD; Gert Kwakkel, PhD

   Conclusions: This systematic review confirms that overall the Bobath Concept is not superior to other approaches. Based on best evidence synthesis, no evidence is available for the superiority of any approach. This review has highlighted many methodological shortcomings in the studies reviewed; further high-quality trials need to be published. Evidence-based guidelines rather than therapist preference should serve as a framework from which therapists should derive the most effective treatment.

6. **Effect of Rhythmic Auditory Stimulation on Gait in stroke Patients with and without Freezing of Gait**

   Pablo Arias, Javier Cudeiro * Neuro science and Motor Control Group (NEURO com), Department of Medicine- INEF, University of A Corufia, A Coruna, Spain

   Velocity and cadence were increased, and turn time reduced in all groups. We conclude that auditory stimulation at the frequency proposed may 'be useful to avoid freezing episodes in PD+FOG.

7. **Rhythmic auditory stimulation in gait training for Stroke's disease patients**

   Dr. M. H. Thaut C. Mclntosh[2], R. R. Rice[1], R. A. Miller[1], J. Rathbun[1] J, M. Brault . Article first published online: 4 NOV 2004

   Conclusion: Evidence for rhythmic entrainment of gait patterns was shown by the ability of the RAS group to reproduce the speed of the last training tape within 2% margin of error without RAS.

8. **Neuro developmental treatment after stroke: a comparative study**

   T Hafsteinsdottir, A Algra, L Kappelle, M Grypdonck, and b on 2005 June;

Conclusions: The NDT approach was not found in the care of stroke patients in the hospital setting. Health care professionals need to reconsider the use of this approach.

9. **Physiotherapy based on the BOBATH concept for adult with post hemiplegia: A review of effectiveness study**

   Matteo Paci J Rehabil Med 2003

   Conclusion: Results show no evidence· proving the effectiveness of Neuro developmental treatment or supporting neuro developmental treatment as the optimal type of treatment, but neither do methodological limitations allow for conclusions of non-efficacy.

10. **Rhythmic facilitation of gait training in hemi paretic stroke rehabilitation**

    Journal, of the Neurological Sciences

    Volume 151, Issue 2, 22 October 1997, Pages 207-212

    M.H. Thaut[a]*. G. C. Mclntosh" band R. R. Riceb

    Conclusion: The data offer evidence that RAS is an efficient tool to, enhance efforts in gait rehabilitation with acute stroke patients.

11. **Physiotherapy based on the Bobath concept in stroke rehabilitation: a survey within the UK**

    200, Vo1.23,No.6, Pages 254-262 (doi.:10.l080/096382801750110892)

    Seila Lennon, David Baxter, Ann Ashburn

    Conclusions: This survey has raised several issues for debate within physiotherapy such as the automatic translation of movement into function, carry over outside therapy, and the way in which tasks should be practiced. The dominance of the Bobath concept needs to be justified by establishing that it is both effective and efficient at achieving its treatment aims of: normalizing tone, improving intrinsic recovery of the affected side and function within everyday tasks.

12. **Gait symmetry and functional walking performance in hemi paretic Patients prior to and after a 4-week rehabilitation programme 3 January 1993**

    SA Hesse MD, MT Jahnke MD, C Schreiner MD and K -H Mauritz MD Klinik Berlin, Department of Neurological Rehabilitation, Freie Universitat Berlin, Germany 3January 1993;

    Conclusions: Although the training of gait symmetry functions is an integral part of the Bobath technique, there was no significant improvement in the gait symmetry parameters. Whereas other functional gait parameters (maximal speed, stair climbing velocity) and the motricity index showed significant improvement.

13. **Training with Computer-Supported Motor Imagery in Post-Stroke Rehabilitation Volume 7, Number 3, 2004**

    A GAGGIOLI, M.S., F. MORGANTI, Ph.D., R. WALKER, B.A., MENEGRINI, M.D.; M.ALCANIZ, Ph.D., J.A. LOZANO, Ph.D., J. MONTESA, Ph.D., J.A. GIL, Ph.D., and G. RIVA, Ph.D.

    The proposed strategy is based on the hypotheses that: (a) combined

physical and mental practice can make a cost-effective contribution to the rehabilitation of stroke patients, (b) effective mental practice is not possible without some form of support, from a therapist (as in our inpatient phase) or from technology (as in the outpatient phase), (c) the inclusion of an outpatient phase will allow the patient to practice more often than would otherwise be possible, therefore increasing the speed and/or effectiveness of learning; and (d) the use of interactive technology will reduce the patient's need for skilled support, therefore .improving the cost-effectiveness of training.

14. **The Rehabilitation of Gait in Patients With Hemiplegia: A Comparison Between Conventional Therapy and Multichannel Functional Electrical Stimulation Therapy**

The combined treatment of conventional treatment along with MFES shows greater improvement than conventional treatment alone.

15. **4.Yang YR, Wang RY, Chan YC, et al.**

Conducted a randomized controlled trial on 25 subjects with chronic stroke. They were divided into 2 groups. The control group (n=12) and experimental group (n=13). Subject in the control group did not receive any rehabilitation training. Subjects in the experimental group received ball exercise program for 4 weeks. Gait performance was measured by using walking speed, cadence, stride time, stride – length. The experimental group showed significant improvement in all selected gait performance than the control group. **This study support efficacy of a dual-task based exercise program to improving walking ability in chronic stroke patients.**

16. Mongerc, carr JH, fowler. V et. al.

Conducted a randomized trial on 6 subjects at least one year post stroke. Task – specific exercise protocol for improving sit to stand, with additional exercise to strengthen lower limb extensor muscle in patients with chronic stroke functional performance of sit to stand was evaluated using the standing up item of the motor assessment scale (MAS), walking speed over 10 meter and grip strength were also measured. This study concluded that a home based task specific exercise and training protocol for sit to stand can induce improved performance of STS and increase walking speed more than one year after stroke. **This study supports the effectiveness of task related exercise programme for sit to stand in post stroke patients.**

STROKE

A stroke, previously known medically as a cerebrovascular accident (CVA), is the rapidly developing loss of brain functions due to disturbance in the- blood supplyto the brain.

A stroke is a medical emergency and can cause permanent neurological. damage, complications, and death. It is the leading cause of adult disability in the developing countries like India and the second leading cause of death worldwide.

Risk factors

- ☞ Hypertension
- ☞ Previous stroke or transient ischemic attack (TIA),
- ☞ High cholesterol,
- ☞ Cigarette smoking and
- ☞ Atrial fibrillation

Classification

Strokescan be classified into two major categories:

1. Ischemic
2. Hemorrhagic

Ischemic strokes

Ischemic strokes are those. that are caused by interruption of the blood supply, About 600/0 of strokes are caused by ischemia, and the remainder by hemorrhage.

Hemorrhagic stroke

Hemorrhagic strokes are the ones which result from rupture of a blood vessel or an abnormal vascular structure. Some hemorrhages develop inside areas of ischemia (“hemorrhagic transformation”).

There are **various classification** systems for acute ischemic stroke. The stroke episode is classified as

- Total anterior circulation infarct (TACI),
- Partial anterior circulation infarct (PACI),
- Lacunar infarct (LACI)
- posterior circulation infarct (POCI)

Signs and symptoms of stroke

If the area of the brain affected contains one of the three prominent central. Nervous system pathways-the spinothalamic tract, corticospinal tract, and dorsal column (medial lemniscus), symptoms may include: hemiplegia and muscle weakness of the face

- Numbness
- Reduction in sensory or vibratory sensation
- Initial flaccidity (hypo tonicity),
- Replaced by spasticity (hyper tonicity),
- Hyper reflexia, and
- Obligatory synergies.

In addition to the above CNS pathways, the brain stem gives rise to most of the twelve cranial nerves. A stroke affecting the brain stem and brain therefore can produce symptoms relating to deficits in these cranial nerves:

- Altered smell, taste, hearing, or vision (total or partial)
- Drooping of eyelid (ptosis) and weakness of ocular muscles
- Decreased reflexes: gag, swallow, pupil reactivity to light
- Decreased sensation and muscle weakness of the face
- Balance problems and nystagmus
- Altered breathing and heart rate

- ☞ Weakness in sternocleidomastoid muscle with inability to tum head to one side
- ☞ Weakness in tongue (inability to protrude and/or move from side to side)

If the cerebral cortex is involved, the CNS pathways can again be affected, but also can produce the following symptoms:

- ☞ Aphasia (difficulty with verbal expression, auditory comprehension, reading and/or writing Broca's or Wernicke's area typically involved)
- ☞ Dysarthria (motor speech disorder resulting from neurological injury)
- ☞ Apraxia (altered voluntary movements)
- ☞ Visual field defect
- ☞ Memory deficits (involvement of temporal lobe)
- ☞ Berni neglect (involvement of parietal lobe)
- ☞ Disorganized thinking, confusion, hypersexual gestures (with involvement of frontal lobe)
- ☞ Anosognosia (persistent denial of the existence of a, usually stroke-related, deficit)

If the cerebellum isinvolved, the patient may have the following:

- ☞ Trouble walking
- ☞ Altered movement coordination
- ☞ Vertigo and or disequilibrium
- ☞ Associated symptoms

History of stroke neuro-rehabilitation

Long before in stroke rehabilitation people were discouraged to be active following stroke. After 1950s this attitude changes and found that prescription therapeutic exercise shows good result. The pioneer work done in exercise prescription and handling by BOBATH, BRUNNSTROM, ROODS brought greatest changes in functional outcome of stroke patient.

In 1950s, Twitchell began studying the pattern of recovery in stroke patients. He reported on 121 patients he had observed. He found that by four weeks, if there is some recovery of hand function, there is a 70% chance of making a full or good recovery. He reported that most recovery happens in the first three months and only minor recovery occurs after six months. More recent research has demonstrated that significant improvement can be made years after the stroke.

Around the same time, Brunnstrom also described the process of recovery, and divided the process into seven stages. As knowledge of the science of brain recovery improves, methods of intervening have evolved. There will be a continue fundamental shift in the processes used to facilitate stroke recovery.

Some of the well-known treatment techniques in stroke rehabilitation are

- Strength Training Post Stroke
- Balance Retraining Post Stroke
- The Bobath Approach / Neuro developmental Technique of Motor
- Task-Specific Training for Mobility
- Motor Relearning Program
- Treadmill Training and Partial Weight Support
- Functional Electrical Stimulation in the Lower Extremity
- Constraint-Induced Movement Therapy for upper extremity motor recovery. Mental Practice

MATERIALS AND METHODOLOGY

MATERIALS

- Couch
- Foot stool
- Blocks\steps
- Chalk
- Inch tape
- Ramp

METHODOLOGY

Study design:

Pre test – Post test experimental study design.

Study setting:

Health Care Institutes approved by college and Guide.

Sampling method:

Simple random sampling method.

Sample size:

A total number of 10 subjects diagnosed as stroke were taken for the study.

Study duration:

The study was conducted for a period of 3 months.

Inclusion criteria:

- Age 40 to 65 years
- Sex – both male and female
- Able to walk 10 meter independently
- Hemiplegia due to cerebrovascular accident of more than 3 months duration.

Exclusion criteria:

- Cerebellar ataxia
- Impaired cognitive function
- Aphasia
- Basal ganglion lesion
- Unconscious patient
- Condition that affect mobility like arthritis disease, spinal abnormalities (or) any amputations.
- Communicative disorder.

Parameters:

(i) Step length:

The linear distance between two successive points of contact of opposite extremities. It's measured by inch tape.

(ii) Stride length:

The linear distance from the point of heel strike to one lower extremity to the next heel strike of the same extremity. Its measured by inch tape.

TREATMENT TECHNIQUES

What is NDT?

NDT is a problem solving approach used for the treatment and management of individuals with motor dysfunction resulting from CNS pathology. The overall goals of treatment and management are to enhance the individual's capacity to function, minimize impairments and prevent disabilities.

Intervention involves direct handling including facilitation and inhibition to optimize function.

History of NDT

Neuro Developmental treatment was first known as the Bobath Approach originated and developed by Mrs. Berta Bobath, Physiotherapist and her husband Dr. Karel Bobath. In polio epidemic era, rehabilitation services opened new doorway for the treatment of children with Neurological disorder.

Mrs. Bobath proposed the idea that children with CP could also benefit from experiences to change the muscle strength and length in order to achieve new functional skill. Mrs. Bobath talked to the body system with her hands and through positioning of the body during functional task.

Over the past 50 years, significant knowledge about the brain and movement science has evolved our understanding of both typical and atypical motor control

Philosophy of NDT

- ☞ Living concept
- ☞ Problem solving approach
- ☞ Hands on.
- ☞ Continual modification of handling
- ☞ Carry over

Principles of NDT

- ☞ Treat the patient as a whole
- ☞ Ongoing individual assessment
- ☞ Tailor made treatment program
- ☞ Emphasize on function
- ☞ Problem solving approach
- ☞ Hands on
- ☞ Active participation
- ☞ Team work - Family, Therapist, Care giver etc
- ☞ Prevention - fore see the problem and should work to prevent it.

Theories supporting NDT

- ☞ Neuronal group selection theory
- ☞ System control theory

Techniques used in NDT to improve gait pattern

- ☞ Sit to stand
- ☞ Lateral weight shift sideward cruising
- ☞ Sideward cruising-crossing and uncrossing legs
- ☞ Lateral weight shift with cruising
- ☞ Symmetrical stance: pivot to step stance

Gait training

- ☞ Hemi Tango
- ☞ Facilitation from upper extremity

RHYTHMIC AUDITORY STIMULATION

Developed primarily by Thaut, Mcintosh and Rice at the Colorado State University. Enhancement of gait is mediated by an entrainment effect where movement frequencies and motor programs entrain to rhythm through anticipatory cuing of functional movement pattern.

RAS uses

Immediate entrainment stimulus that stimulate walking tempo, balance, and control of muscles.

Mechanism

- ☞ Rhythmic entrainment
- ☞ Priming of auditory pathway
- ☞ Cuing of movement period
- ☞ Step wise limit cycle entrainment

Rhythmic entrainment

Rhythmic pattern act as an external oscillator which has magnetic effect on one's internal time keeper

This periodic pattern of rhythm enhances, the patient temporal parameter of walking pattern

Priming of auditory pathway

Entrainment of muscle activation through rhythm, pattern takes place via reticulo spinal tract. Many motor synchronization can be easily achieved through entraining by listening to rhythm.

Cuing of the movement period

Adaptation of movement duration to the rhythmic stimulation can be achieved through this treatment program. Kinematic model shows that periodic entrainment results in enhancing kinematic stability through the stabilization of the following parameters (acceleration, velocity, and trajectory)

Step wise limit cycle entrainment (SLICE)

First RAS frequencies are set in synchronized with frequency of patient movement Limit cycles are frequencies at which any moving object performs optimally. Initial purpose of RAS is to stabilize movement parameters at the patient current limit cycle. Then the limit cycle are gradually entrained through a step wide incremental process

Normal Gait

Series of rhythmical, alternating movements of the trunk & limbs which result in the forward progression of the center of gravity

Gait Cycle

- ☞ Single sequence of functions by one limb
- ☞ Begins when reference font contacts the ground
- ☞ Ends with subsequent floor contact of the same foot

Step Length

- ☞ Distance between corresponding successive points of heel contact of the opposite feet
- ☞ Rt step length = Lt step length (in normal gait)

Stride Length

- ☞ Distance between successive points of heel contact of the same foot
- ☞ Double the step length (in normal gait)

Walking Base

- ☞ Side-to-side distance between the line of the two feet
- ☞ Also known as 'stride width'

Cadence

- ☞ Number of steps per unit time
- ☞ Normal: 100 - 115 steps/min
- ☞ Cultural/social variations

Velocity

- ☞ Distance covered by the body in unit time
- ☞ Usually measured in m/s
- ☞ Instantaneous velocity varies during the gait cycle
- ☞ Average velocity. (m/min) = step length (m) x cadence (steps/min)

Comfortable Walking Speed (CWS)

- ☞ Least energy consumption per unit distance
- ☞ Average= 80 m/min (~ 5 km/h ~ 3 mph)

Phases:

Stance Phase:

Reference limb
In contact
With the floor

Swing Phase:

Reference limb
not in contact
with the floor

Support:

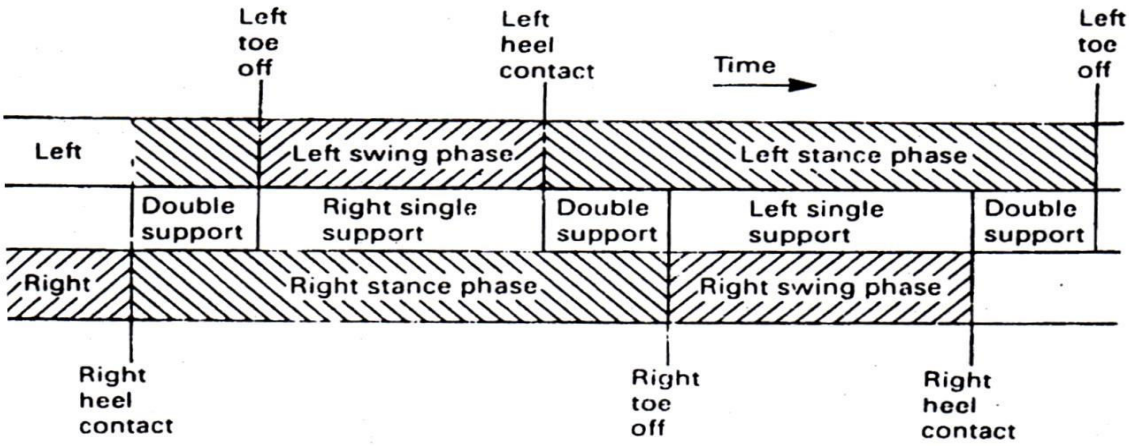
- **Single Support:** only one foot in contact with the floor
- **Double Support:** both feet in contact with floor

A. Stance phase:

1. **Heel contact:** 'Initial contact'
2. **Foot-flat:** 'Loading response', initial contact of forefoot w. ground
3. **Midstance:** greater trochanter in alignment w. vertical bisector of foot
4. **Heel-off:** 'Terminal stance'
5. **Toe-off:** 'Pre-swing'

B. Swing phase:

1. **Acceleration**: 'Initial swing'
2. **Midswing:** swinging limb overtakes the limb in stance
3. Deceleration: 'Terminal swing'



Time Frame:

A. Stance vs. Swing:

Stance phase = 60% of gait cycle

Swing phase = 40%

B. Single vs. Double support:

- ☞ Single support= 40% of gait cycle
- ☞ Double support= 20%

◈ **With increasing walking speeds:**

- ☞ **Stance phase:** Decreases
- ☞ **Swing phase:** Increases
- ☞ **Double support:** Decreases

◈ **Running:**

- ☞ By definition: walking without double support
- ☞ Ratio stance/swing reverses
- ☞ Double support disappears. 'Double swing' 'develops

◈ **Center of Gravity (CG):**

- ☞ midway between the hips
- ☞ Few em in front of S2

◈ **Least energy consumption if CG travels in straight line**

- ☞ Path of Center of Gravity

A. <u>Vertical displacement:</u>

- ☞ Rhythmic up & down movement
- ☞ Lateral limit: midstance
- ☞ Average displacement: 5cm
- ☞ Path: extremely smooth sinusoidal curve

B. <u>Lateral displacement</u>:

- ☞ Rhythmic side-to-side movement
- ☞ Lateral limit: midstance
- ☞ Average displacement: 5cm
- ☞ Path: extremely smooth sinusoidal curve

C. Overall displacement:

- ☞ Sum of vertical & horizontal displacement
- ☞ Figure ‘8’ movement of CG as seen from AP view

Determinants of Gait:

- ☞ Six optimizations used to minimize excursion of CG in vertical & horizontal
  Planes.
- ☞ Reduce significantly energy consumption of ambulation Classic
  papers: Sanders, Inman (1953)

1) Pelvic rotation:

- ☞ Forward rotation of the pelvis in the horizontal plane swing-phase side
- ☞ Reduces the angle of hip flexion & extension
- ☞ Enables a slightly longer step-length w/o further lowing of CG

2) Pelvic tilt:

- ☞ 5o dip of the swinging side (i.e. hip adduction)
- ☞ In standing, this dip is a positive Trendelenberg sign
- ☞ Reduces the height of the apex of the curve of CG

3) Knee flee

4) Xian in stance phase:

- ☞ Approx. 20° dip
- ☞ Shortens the leg in the middle of stance phase
- ☞ Reduces the height of the apex of the curve of CG

5) Ankle mechanism:

- ☞ Lengthens the leg at heel contact
- ☞ Smoothens the curve of CG
- ☞ Reduces the lowering of CG

6) Foot mechanism:

- ☞ Lengthens the leg at toe-off as ankle moves from dorsiflexion to plantar flexion.
- ☞ Smoothens the curve of CG
- ☞ Reduces the lowering of CG

7) Lateral displacement of body:

- ☞ The normally narrow width of the walking base minimizes the lateral displacement of CG
- ☞ Reduced muscular energy consumption due to reduced lateral acceleration & deceleration

Gait impairment in stroke

Gait impairment is common after Stroke with 60% of survivors living with a walking-related disability. Walking incorrectly not only creates a stigma for these patients but it also makes them more susceptible to injury and directly affects their quality of life.

Following stroke it leads to motor weakness, sensory and proprioceptive deficits, intellectual impairment, emotional distress and motivational and social problems. Although most stroke patients regain walking independence, many have continuingproblems with mobility due to impaired balance, motor weakness, and decreased walking velocity.
For normal walking, the brain relies on:

- ☞ Proper sense of timing and rhythm in performing actions
- ☞ A clear sense of direction of the targeted movement
- ☞ Internal sensory feedback telling the brain that the body is moving
- ☞ External sensory feedback to movement through vision, hearing and touch

Statistical tool:

The statistical tools used in the study were paired 't' test.

Paired 't' test:

The paired 't' test was used to find out the statistical significance between pre and posttest of patients treated with progressive resistance exercise separately.

Formula: Paired 't' test:

`

$$S=\rho\varphi d^2-\frac{(_{\varphi}\ d)^2}{n}$$

$$n\ -1$$

$$t = \frac{\overline{d}_{\rho}\ \overline{n}}{s}$$

d = difference between pre test Vs post test values

$\overline{d}$ = mean difference

n = total number of subjects

s = standard deviation.

DATA PRESENTATION

TABLE – I

S.No	Step length (cm)		Stride length (cm)	
	Pretest	**Post test**	**Pretest**	**Post test**
1.	44	68	64.3	108.8
2.	41	59	73	112.2
3.	43	65	56	105.8
4.	39	57.5	63.2	118.3
5.	37	55.5	58.1	98.2
6.	40	60	66.3	100.3
7.	45.1	70	70.1	109.7
8.	44.5	58	59	113.7
9.	38	67.2	65	102.5
10.	42	66.6	63.4	108.2s

DATA ANALYSIS AND INTERPRETATION

TABLE – II

Table II represents the mean values, mean difference standard deviation, and paired 't' value between pre test vs post test values of step length test in stroke who have been subjected to test –rhythmic auditory stimulation along with NDT to improve the Gait pattern in post stroke patients

S.No	Step length	Mean	Mean difference	Standard deviation	Paired 't' value
1.	Pre test	41.36	21.32	4.50	14.9
2.	Post test	62.68			

Table II show the analysis of the paired 't' value of pre Vs post sessions of stroke patients was 14.9 at 0.05 level of significance, which was greater than the tabulated value of 2.26. This showed that there was a statistical significant difference between pre Vs post test result. The pre test mean was 41.36, the post test mean was 62.68 and mean difference was 21.32, which showed that there was an increase in step length in post test indicating the recovery of selected samples in response to intervention.

GRAPH I-PRE AND POST TEST VALUE OF STEP LENGTH

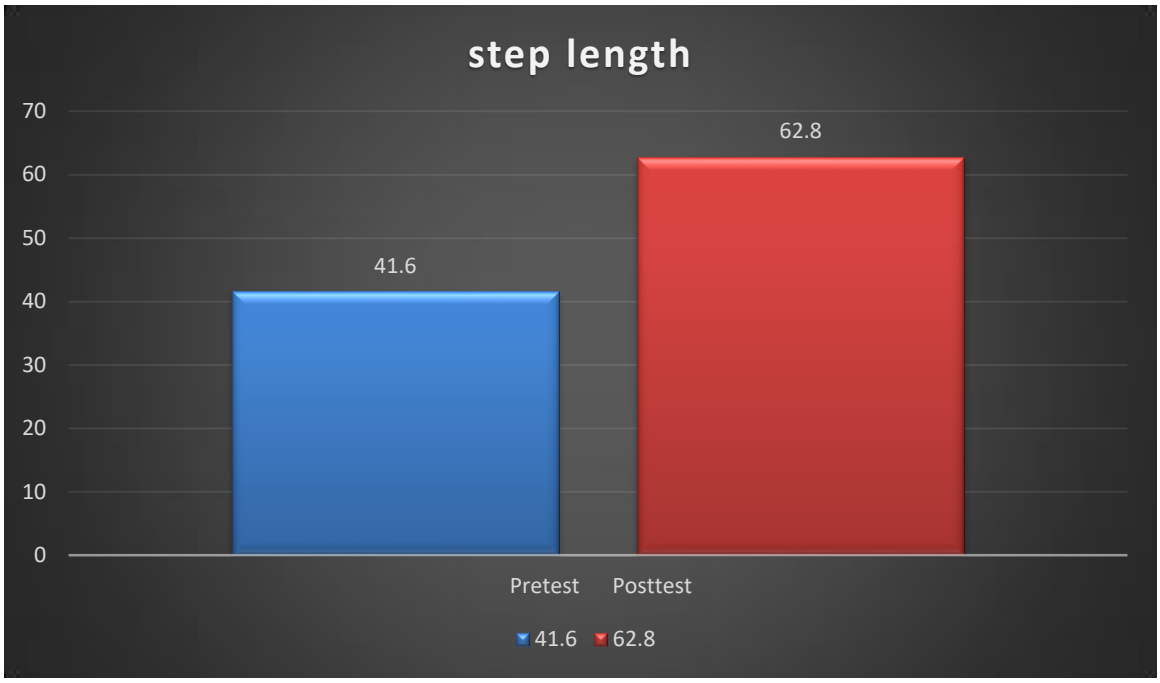


TABLE III

Table III represents the mean values, mean difference, standard deviation and paired‘t’ value between pretest Vs post test value of stride length test who have been subjected to task – rhythmic auditory stimulation along with NDT to improve gait training.

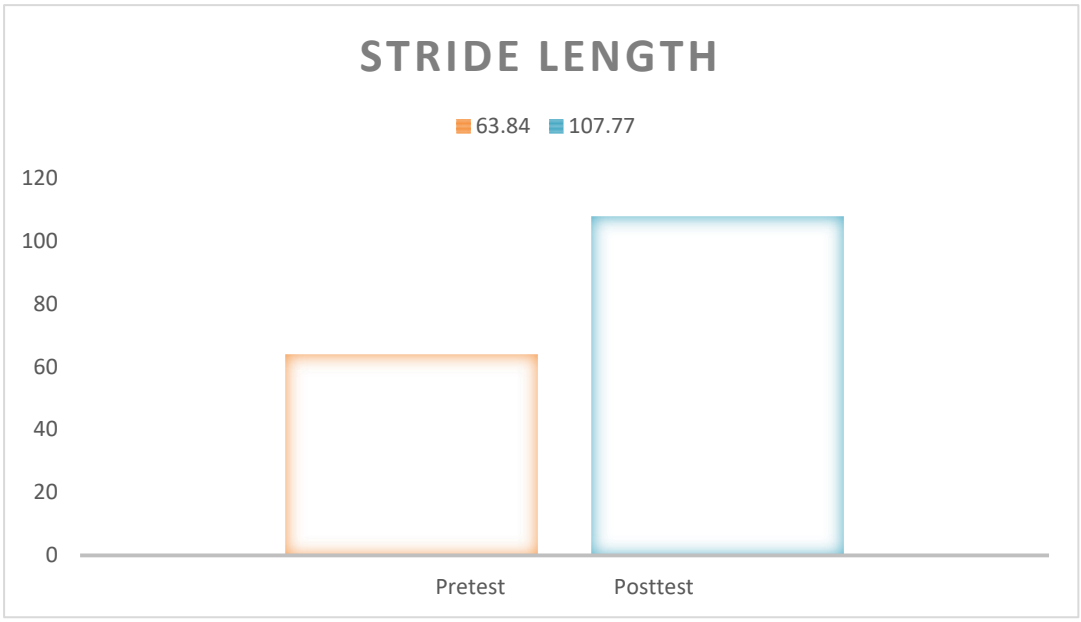
S.No	Stride length	Mean	Mean difference	Standard deviation	Paired ‘t’ value
1.	Pre test	63.84	43.93	46.63	2.97
2.	Post test	107.77			

Table III shows the analysis of the paired ‘t’ value of pre Vs post sessions of stroke patients was 2.97 at 0.05 level of significance, which was greater than the tabulated value of 2.26 this showed that there was a statistical significant difference in between pre Vs post test results. The pre test mean was 63.84, the post test mean was 107.77 and mean difference was 43.93, which showed that the was on increasing step length in post test indicating the recovery of selected samples in response to intervention.

Therefore, the present study is rejecting the null hypothesis and accepting the alternate hypothesis’s

GRAPH II-

PRE AND POST TEST VALUE OF STRIDE LENGTH



RESULT AND DISCUSSIONS

The aim of the study is to determine the effect of rhythmic auditory stimulation along with NDT to improve gait training in stroke patients.

A total number of 10 patients who were diagnosed with stroke with lower limb muscles weakness were selected for the study.

The most common cause for stroke is due to occlusion of one of the major cerebral artery especially anterior cerebral artery. The stroke patient has reduced functional mobility and reduced leg function and spasticity.

Deana and Richards (2000) suggested that rhythmic auditory stimulation along with NDT training had a greater contribution in improving the lower limb extensor muscles after the intervention.

At thighs-off, the centre of the body mass has moved forward over the feet. This position ensures that the relative position of body segment at thighs-off enables lower limb extensor forces to accelerate the body vertically into the standing position. (Carr 2009).

Stepping up and down in difference direction (forward and sideways) strengthen difference synergic relationship between hip, knee, ankle extensor and hip abductors or adductors to train in different pattern muscles activation and flexible walking performance. **(Shepherd 2000).**

Repetitive stepping exercise using of various steps of various heights increase the strength in the lower extensor muscle.

Reaching forward, sideways and in different direction help the individual regain strength and control of the lower limbs, which may enable them to take more weight through the affected leg.

Therefore there is mounting evidence that progressive resistance training is effective in improving gait pattern following stroke.

CONCLUSION

The study concluded that was the rhythmic auditory stimulation along with NDT effective treatment for improving gait pattern in stroke patients. And also step length and stride length test could be used as the assessment tool for stroke patients.

RECOMMENDATION FOR FURTHER STUDY

- A similar study can be conducted for other neurologically disabled patients.
- A similar study can be conducted for stroke people of acute stages.
- A similar study can be conducted to show the changes of gait parameters in stroke subjects.
- We shall alone compare the effect if RAS with other Task Specific programs.

Limitations of this study

- The study was done for a small sample size. In order to generalize the findings, studies must be done with larger samples.
- The study was conducted only on MCA affected stroke and need to conduct studies on patient who are affected on other blood vessels of brain.
- Other measures can be included such as functional activities, hand function, skilled voluntary control to document the improvement.

REFERENCES

1. Hand book of Neurological rehabilitation second Edition Edited by Greenwood, Barnes, McMillan and Ward 2003. Hove: Psychology Press
2. Neuro-Rehabilitation in Stroke: Carolee J. Winstein, PhD, PT, FAPTA University of Southern California
   Western States Stroke Consortium: Seattle, WA, Sept 13-14,2003
3. Physical medicine and rehabilitation Edited by Sara Cuccurullo, MD.
4. Neurological Stroke Rehabilitation [Hardcover]Nicholas A. osseff (Editor), Losseff (Author)
5. DeLisa's Physical Medicine and Rehabilitation: Principles and Practice Source:Lippincott Williams & Wilkins (LWW) Author(s): Frontera, Walter R.; Gans, Bruce M.; Walsh, Nicolas E.; Robinson, Lawrence R.
6. Bobath Concept- Title: Bobath Concept: Theory and Clinical Practice In Neurological Rehabilitation - Author: Linzi Meadows, Sue Raine, Mary Lynch -Ellerington
7. Adult Hemiplegia: Evaluation and Treatment- Title: Adult Hemiplegia: Evaluation and Treatment - Author: Berta Bobath
8. Clinical Applications for Motor Control - Title: Clinical Applications for Motor Control - Author: Patricia Montgomery, Barbara H. Connolly
9. Community Rehabilitation in Neurology - Title: Community Rehabilitation in Neurology ~ Author: Michael P. Barnes, Harriet Radermacher
10. Evidence Based Review of Stroke Rehabilitation, Title: Evidence Based Review of Stroke Rehabilitation: Painful Hemiplegic Shoulder - Author: Robert Teasell, Sanjit K. Bhogal, Norine Foley
11. Neurological Stroke Rehabilitation- Title: Neurological. Stroke Rehabilitation - Author: Nick Losseff.
12. Motor Control and Sensory-Motor Integration- Title: Motor Control and Sensory-Motor Integration (Advances in Psychology) - Author: D.J Glencross, J P. Piek.

13. Progress in Motor Control: A Multidisciplinary ..- Title: Progress in Motor Control: A Multidisciplinary Perspective - Author: Dagmar Sternad
14. Neurological Physiotherapy- Title: Neurological Physiotherapy: Bases of Evidence for Practice, Treatment and Management of Patients Described by Specialist Clinicians - Author: Cecily Partridge
15. Textbook of Neural Repair and Rehabilitation Vol 1- Title: Textbook of Neural Repair and Rehabilitation: Volume 1, Neural Repair and Plasticity Author: Michael Selzer, Stephanie Clarke, Leonardo Cohen, Pamela Duncan, Fred Gage.
16. Upper Motor Neuron and· Spasticity-Title: Upper Motor Neurone Syndrome and Spasticity: Clinical Management and Neurophysiology-Author: Michael P..Bames, Garth R. Jolmson.
17. Neuro-developmental Treatment Approach- Title: Neuro-developmental Treatment Approach: Theoretical Foundations & Principles- Author: Janet M Howle.
18. Rehabilitation and Health Assessment- Title: Rehabilitation and Health Assessment: Applying ICF Guidelines- Author: Elias Mpofu, Thomas Oakland.
19. Essential Physical Medicine and Rehabilitation- Title: Essential Physical Medicine and Rehabilitation-Author: Grant Cooper
20. Gait Disorders: Evaluation and Management- Title: Gait Disorders: Evaluation and Management - Author: James Ashton-Miller

PROFORMA

Name :

Age :

Sex :

Occupation :

Address :

Chief complaints :

Present medical history :

Past medical history :

Family History :

Associated problems :

Vital signs :

Objective Examination :

On observations :

- Posture
- Gait
- Attitude if the limb
- Deformity
- External appliances
- Vision
- Tropical changes
- Behavior
- Speech

On palpation

- Muscle tone :
- Warmth :
- Tenderness :
- Edema :

On examination :

Higher mental function

Sensory assessment

- Orientation
- Memory
- Communication
- Emotional status
- Spasticity grade
- Reflexes
- Superficial
- Deep tendon reflexes

D.T.R	RT	LT
K.J		
A.J		

Motor assessment

- Muscle power: MRC (Grading)

Muscles	Right	Left
Hip flexor		
Hip extensor		
Knee flexor		
Knee extensor		
Ankle plantar flexion		
Ankle dorsiflexion		

- Muscle tone :
- Reflex examination : Deep tendon reflex

Diagnosis

Treatment

Rhythmic Auditory stimulation along with NDT

Prognosis

Treatment Parameter	Pre Test	Post Test
Step length		
Stride length		