

**“A Comparative Study to Analyze the Effect of Bilateral Arm training with Rhythmic Auditory Cueing (BATRAC) Physiotherapy and Conventional (traditional) Physiotherapy alone (CPA) in Chronic Hemiparetic Stroke Subjects..”**

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**ABSTRACT**

The study was designed with the purpose of comparing the effectiveness of Bilateral Arm training with Rhythmic Auditory Cueing (BATRAC) Physiotherapy and Conventional (traditional) Physiotherapy alone (CPA) in chronic hemiparetic stroke subjects. **[Subjects and Methods]** A sample of convenience of 32 subjects with chronic hemiparetic arm dysfunction took part in the study, which were divided into two groups of 16 patients each. Group A (Control Group) received CPA intervention (n=16) and Group B (Experimental Group) received BATRAC intervention (n=16). Paired t-test and unpaired t-test ( $p < 0.05$ ) were used to interpret the pre test and post test scores within groups and between groups respectively based on the wolf motor function test (WMFT). **(Results)** Outcome measures for both the groups were compared for improvement in physical function of upper extremity hemiparesis at the end of 6 weeks of clinical intervention and reveals significant maximum improvement in **BARTRAC** group B subjects [Post WMFT<sub>B</sub> (X=47, SD=4.54)] are far much better than CPA group A subjects [Post WMFT<sub>A</sub> (X=27.93, SD=3.94)]. **(Conclusion)** This study concludes that the subjects benefitted maximally if BARTRAC intervention was given or conduct along with the CPA, thus proving the hypothesis of the study.

**Keywords:** Stroke, Hemiparetic, Physical Function, Rehabilitation

## INTRODUCTION

Stroke or "Brain Attack" or Acute Ischaemic Cerebrovascular Accident is the clinical designation for a rapid loss of brain function due to disturbance in blood vessels supplying blood to the brain<sup>1</sup>. Chronic upper extremity hemiparesis is a leading cause of functional disability after stroke. Specifically, dysfunction from upper extremity hemiparesis impairs performance of many activities of daily life such as dressing, bathing, self care and writing, thus reducing functional independence<sup>2</sup>. Traditionally, stroke rehabilitation strategies have shown to improve motor function only minimally in which the patient relearns movements using the unaffected limb, rather than actual affected arm<sup>3</sup>.

Recently BATRAC has been the interest of many researchers to improve bilateral symmetry in chronic hemiparetic subjects. According to Jill Whitall, BATRAC refers to Bilateral Arm training with Rhythmic Auditory Cueing, A specialized arm exercise that differs from regular workouts and traditional therapeutic exercises for stroke recovery. It uses sound cues to signal participants to start pushing or pulling on two t-bar handles, either using both arms at the same time or taking turns with each arm. It delivers controlled, bilateral, rhythmic movements to the upper limb<sup>2</sup>. Apart from traditional intervention, there have been evidences in technique for upper extremity recovery in stroke such as CIMT (Taub & Wolf, 1997), neurodevelopmental or bobath approach (Howle,2003), EMG-initiated electrical stimulation (Carraugh et al, 2001), repetitive training of isolated movements (Butefisch, Hummelsheim, Denzler and Muritz, 1995), PNF (Knott & Vose, 1968), but bilateral training has gained importance in last few years<sup>4,5</sup>.

## PREVIOUS REVIEWS

1. **Bütefish, C., Hummelsheim, H., Denzler, P., & Mauritz, K. (1995)** investigates the effects of repetitive training to rehabilitate a paretic hand. To achieve a baseline, patients received normal treatments utilizing the Bobath concept, a conventional physiotherapeutic method. Using a multiple baseline approach, the authors were able to analyze the effect of specific trainings on three basic motor function of the hand; grip strength, isometric and isotonic hand extension. Twenty-seven hemiparetic individuals were placed into two groups; one receiving enhanced non-specific therapy and another receiving enhanced specific therapy. Group one received specific standardized training using rapid and repetitive movements trained twice a day for 15 minute periods. The second group was exposed to transcutaneous electrical nerve stimulation (TENS) as an enhanced non-specific intervention for the same amount of time as group one following the baseline phase. Group two received the same training as group one after completion of the TENS treatment. As a result, TENS did not achieve a reasonable improvement when compared to the baseline. It was also deduced the standardized motor training was successful in improving specific movement parameters of the hand as well as its functional motor deficit significantly (Bütefish et al. 1995). The authors consider repetitive training is crucial for the course of motor recovery<sup>6</sup>.
2. **Whitall J, McCombe Waller S, Silver KH, Macko RF (2000)** in their study find out that repetitive bilateral arm training with rhythmic auditory cueing improves motor function in chronic hemiparetic stroke. This is a single group pilot study and after six weeks of BATRAC intervention there is improvement in functional motor performance of the paretic upper extremity as well as a few changes in isometric strength and range of motion. These benefits are largely sustained at 8 weeks after training cessation<sup>7</sup>.
3. **Mudie, M., & Matyas, T. (2000)** tested the hypothesis of whether simultaneous bilateral movements encourage the reconstruction of neural networks that have been damaged by stroke. The authors believe bilateral isokinematic training (BIT) can encourage movement pattern reorganization through mechanisms for the hemiplegic extremities that are not

accessible by unilateral training. Twelve patients participated in eight weeks of training utilizing three standardized “reach-to-target” tests. The results of this study showed BIT improved kinematic patterns of unilateral hemiplegic limb performance rapidly in patients<sup>8</sup>.

4. The researchers **Thaut, M., Kenyon, G., Hurt, C., McIntosh, G., & Hoemberg, V. (2002)** provide insight into effect of rhythm on paretic arm function. The researchers used an isochronous metronome stimulus to prompt reaching movement. The data was then compared to that of non-prompted repetitive training. Because the arm and hand can learn skills involved “high performance environments” such as sports, the authors believed teaching these extremities to operate via rhythmic cue would effectively rehabilitate a paretic arm. To identify the changes realized from the rhythmic cueing, a mathematical optimization model was applied. Data provided by the authors showed a significant improved in arm kinematics exposed to rhythm. With the results obtained from this study; the authors suggest auditory rhythm attributed to significant kinematic stability to the patient’s paretic arm<sup>9</sup>.
5. **Jang, S., Kim, Y., Cho, S., Lee, J., Park, J., & Kwon, Y. (2003)** in their study involved task-oriented training and its effect on the cortex of hemiparetic stroke patients. The training occurred 40 minutes a day four days a week for four weeks. Information gathered from the research was assessed by fMRI. Subjects were asked to perform six tasks that affected upper extremity function such as switching two switches, five different color switches, grasping and release, transferring objects from one location to another, and throwing balls. The outcome was visually positive. The fMRI results showed the affected contralateral sensorimotor cortex was newly activated when subject performed hand movements. Overall, an increase in cortical reorganization was evident in affected sensorimotor cortex activity and a decrease of sensorimotor cortex activity was seen in unaffected areas<sup>10</sup>.
6. **Whitall, J., McCombe Waller, S., Luft, A., Hanley, D. (2006)** in their case report, one subject with chronic hemiparesis demonstrated motor function gains as well as new contralesional activation after 6 weeks of BATRAC<sup>11</sup>.
7. **S., & Whitall, J. (2008)** in this paper discusses the benefits and utility of bilateral arm training for stroke patients with paralysis of all severity levels<sup>12</sup>.

## OBJECTIVES OF THE STUDY

- ❖ To find out the effect of Conventional (traditional) Physiotherapy alone (CPA) intervention in chronic hemiparetic stroke subjects.
- ❖ To find out the effectiveness of Bilateral Arm training with Rhythmic Auditory Cueing (BATRAC) intervention in chronic hemiparetic stroke subjects.
- ❖ The objective of the study is to compare the effectiveness of BATRAC and CPA interventions in chronic hemiparetic stroke subjects.

## NEED FOR THE STUDY

Bilaterality is inherent, most human movements involve a linkage between limbs as in weaving, stacking, manipulating or folding objects, piano playing, typing etc. Experiments demonstrate that our limbs are temporally and spatially locked that is entrained. It is believed that this entrainment effect of a single neural mechanism controlling spatial and temporal aspects is an effect of a single neural mechanism controlling spatial and temporal aspects of movements for both limbs. Following stroke the entrainment effect is retained. Researchers suggest that a particular patient who is unable to voluntarily move the affected arm by itself can often move the arm when bilateral practice strategies are employed. Till date a very few researchers has been carried out the efficacy of BATRAC as a recent experimental exercise regime. Thus, the need of this study was to determine the benefits of BATRAC intervention in chronic hemiparetic stroke subjects.

## RESEARCH METHODOLOGY

Research methodology is the procedure for conducting the research. A lot of attention has to be devoted to the procedure and step of the research of the researcher wishes to have any claims on objectivity or if he wishes to establish a truth and gain wide acceptability. Research Methodology guiding the present research work has been explained under the following sub head.

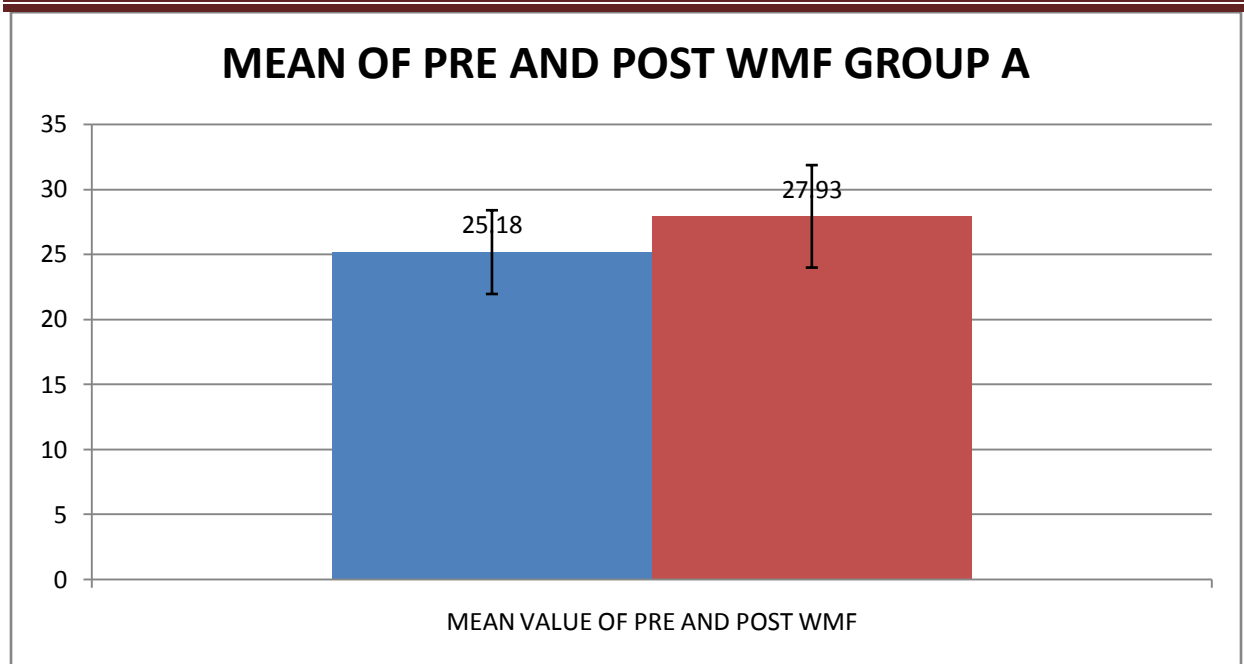
- ❖ **Research Design:** Experimental study with different subject design.
- ❖ **Subjects:** The subjects were 32 chronic hemiparetic arm dysfunction stroke subjects, who were divided into two groups of 16 subjects each. To be eligible for the study the subjects should fulfill the following inclusion and exclusion criteria. They were given BATRAC and CPA for 30 minutes per session, 5 times a week, for 6 weeks.  
Group A- Control Group: Consisting of 16 subjects who received CPA.  
Group B- Experimental Group: Consisting of 16 subjects who received BATRAC physiotherapy.
- ❖ **Sample:** Both the groups consisted of 6 females and 10 males. Group A had a mean age of  $52.31 \pm 5.42$  years and group B had a mean age of  $52.56 \pm 5.53$  years.
- ❖ **Data Collection Method:** University inpatient rehabilitation and outpatient clinic with diagnosis of chronic hemiparetic stroke patients.
- ❖ **Protocol:** All subjects were assessed on 15 tasks of WMFT. Pre and post scores were assessed during the respective therapies.

## DATA ANALYSIS & INTERPRETATION

The following outcomes were measured throughout the intervention phase of the study. The table 1 showing Mean and SD of WMF<sub>A</sub> at pre and post intervention for group A. The analysis of the total ability scores show significant improvements in the post WMFT<sub>A</sub> [ $X=29.93$ ,  $SD=3.94$ ] than pre WMFT<sub>A</sub> [ $X=25.18$ ,  $SD=3.22$ ] with t-value = -12.84 ( $p < 0.05$ ) in the ability of the individual to perform the task after conventional physiotherapy.

Pre WMF <sub>A</sub>	Post WMF <sub>A</sub>	t value	P value
Mean $\pm$ SD	Mean $\pm$ SD		
25.18 $\pm$ 3.22	27.93 $\pm$ 3.94	-12.84	p<0.05

Table1- Mean and SD of WMF<sub>A</sub> at Pre and Post Intervention for Group A (CPA)

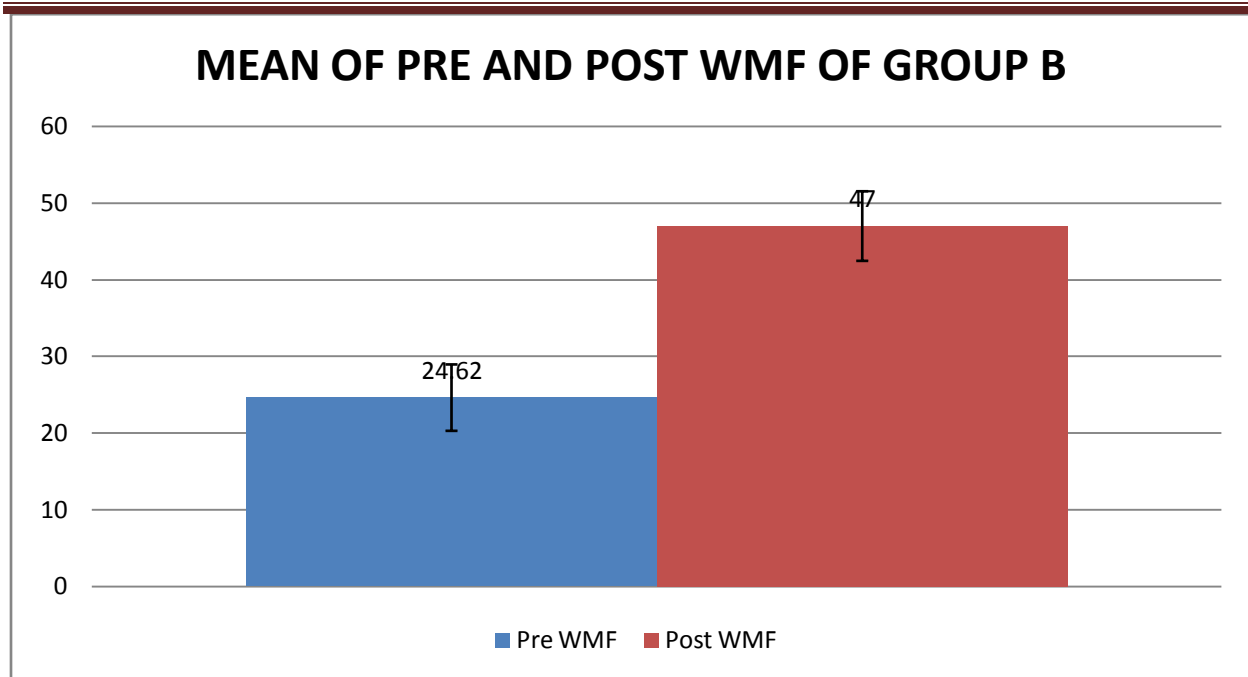


Graph 1- Comparison of of WMF<sub>A</sub> at Pre and Post Intervention for Group A (CPA)

The tables-2 showing Mean and SD of WMF<sub>B</sub> at pre and post intervention for group B. The total ability scores improved significantly in the post WMF<sub>B</sub>[X=47, SD=4.54] and pre WMF<sub>B</sub>[X=24.62, SD=4.33] with t-value= -46.42 (p<0.05) in the ability of the individual to perform the task after BATRAC physiotherapy.

Pre WMF <sub>B</sub>	Post WMF <sub>B</sub>	t value	P value
Mean ± SD	Mean ± SD		
24.62±4.33	47.00±4.54	-46.42	p<0.05

Table 2- Mean and SD of WMF<sub>B</sub> at Pre and Post Intervention for Experimental Group B (BATRAC)



Graph 2- Comparison of WMF<sub>B</sub> at Pre and Post Intervention for Control Group B (BATRAC)

The table 3 showing the analysis of the scores of post WMFT<sub>B</sub>[X=47, SD=4.54] and post WMFT<sub>A</sub>[X=25.18, SD=3.22] reveals significant improvements at t-value= -13.221 ( $p < 0.01$ ) in improving motor function in chronic upper extremity hemiparetic subjects.

Post Interval	CPA Group A Vs BATRAC Group B	
WMF	T value	p value
	-13.221	P<0.01

Table 3-Comparison of Mean Values for WMF at Post Interval between Group A and Group B

Thus, an overall analysis of various scores showed that maximum improvement occurred when BATRAC intervention was given. This revealed that this intervention showed improvement in the functional ability of the subjects, thereby improving their motor function in the hemiparetic upper extremity.

## DISCUSSION

This present study looked into *the comparison of effectiveness of BATRAC and CPA interventions in chronic hemiparetic stroke subjects*. After exploratory the final clinical results through charts, from an experimental view we observe that the BATRAC Group B showed the biggest improvement among the two groups. This was similar to the results of the study conducted by Andreas R. Luft, Sandy Mc Combe Waller et al (2004), concluded that BATRAC induces reorganization in contralesional motor networks and provides biological plausibility for repetitive bilateral training as a potential therapy for upper extremity rehabilitation in hemiparetic stroke. In this study it was also found that a 9-year-old stroke subject reported significant improvements in the functional ability on the WMFT after the intervention. This study has some limitations in generalization because we cannot say this is the same case for all stroke patients. Also, the study did not include severe spastic subjects so the score cannot be generalized to all the stroke subjects with varying spasticity. Additionally, this study documented the motor function improvement by WMFT, its validity on the other outcomes measures could not be determined.

## CONCLUSION

The rehabilitation period is very important in the increase of the functional independency level of the patients after stroke. Our results suggest that repetitive BATRAC intervention has a clinically significant efficacy in improving motor function in the hemiparetic upper extremity in chronic stroke subjects. In last, it would be more effective to conduct such interventions for the standards of care in rehabilitation programs.

## FUTURE RELEVANCE OF THE STUDIES

It is reasonable to assume that such training would also be effective in many patients if implemented early after stroke, when the potential for neuroplasticity may be greatest. Studies could be conducted with bilateral arm training apparatus where adjustments could be more individualized. It is also possible that altered training periods, or other variations of BATRAC including progressive or incremental resistive components, could result in greater motor and function gains. If conducted with some modification in the apparatus or the protocol even severe spastic stroke subjects might be benefited.

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