



## THE EFFECT OF ACTIVE PASSIVE TRAINER ON LOWER LIMB FUNCTIONS AMONG THE STROKE PATIENTS: A PILOT STUDY

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### ABSTRACT

**Objective:** To assess the effect of Active Passive Trainer on lower limb spasticity and functional ability in stroke patients **Method:** In this study 10 participants of age group 30-60 years diagnosed with stroke were taken. The participants were patients undergoing treatment at MGM Physiotherapy Rehabilitation and Fitness Centre. Sampling was done in accordance with inclusion and exclusion criteria. The participants received 30 minutes of APT 5 days per week for 4 weeks in addition to the usual conventional therapy. The outcome measures Modified Ashworth Scale, Functional Independence Measure and Voluntary Control Grading and Fugl-Meyer Assessment scale were used before and after the treatment period. **Result:** All patients exhibited a good prognosis. At the end of treatment they showed greater control over the limb, 8 patients noticed reduction in spasticity. The Modified Ashworth Scale score decreased significantly ( $p=0.002$ ) with the mean value pretreatment being 1.5 and post treatment 1.1. the biggest difference was seen in Functional Independence Measure score ( $p<0.001$ ) with the mean difference being 8.500. **Interpretation:** This study provides evidence of positive effects of Active Passive Trainer in terms of improving spasticity, voluntary control and independence in stroke patients after 4 weeks of treatment.

### KEYWORDS :

#### INTRODUCTION:

One of the major causes of death and disability in India is stroke.<sup>1</sup> Ischaemic stroke, hemorrhagic stroke, transient ischaemic attack, and cryptogenic stroke are the most prevalent kinds of stroke. The most frequent of them, accounting for around 87 percent of all strokes, is the ischemic stroke.<sup>2</sup>

In stroke rehabilitation a number of different approaches can be undertaken as per the needs of the patient and the judgment of the therapist. Motor relearning program, Neurodevelopment technique, constraint induced movement therapy, are a few of the commonly used approaches. Along with these the therapist may use electrical stimulation like functional electrical stimulation and/or use technological devices like Active Passive Trainer.

The active passive trainer (APT) is an electronically powered trainer used for rehabilitation of the lower limb. It helps patients by promoting limb movement through ranges of motion. The feature of passive assistance helps decrease patient workload while still maintaining movement through the complete available range. It can also simultaneously help in increasing strength.

Active passive trainer emulates the motion of cycling. Studies have shown that subacute and chronic stroke patients that received cycling training displayed improvements in strength, functional capacity, balance and cardiorespiratory fitness.<sup>10</sup>

Active Passive trainers can be used by people with all levels of disability as they provide cycling from a chair or wheelchair and the speed, resistance and type of exercise (active, active assisted or passive) can be adjusted depending on the user's level of ability. Users receive visual feedback on their speed, distance cycled actively and passively, power output and symmetry of cycling which increases motivation, facilitates motor learning/control and improves rehabilitation outcomes.<sup>3</sup>

Active passive trainers help increase range of motion- through repetitive movements and passive and assistive modes,

reduce spasm- the various modes facilitate slow and controlled rhythmic movements of extremities, increases muscle strength- The APT trainer enables muscle strength training by concentrically flexing and extending the main joints of the extremities, using different levels of resistance, increasing stamina and improving blood circulation.

Albeit Active passive trainers are used clinically, there is a lack of definite evidence about their effect on post stroke spasticity. Thus, this study is designed to appraise the effect of APT on lower limb functional ability in stroke patients.

#### METHODS:

All stroke patients who met the inclusion and exclusion requirements and visited the MGM Physiotherapy Rehabilitation and Fitness Centre in Aurangabad, Maharashtra, were invited to participate. For inclusion, patients had to have a diagnosis of stroke, be between the ages of 30 and 60, have Spasticity Grade 1+ on the Modified Ashworth Scale (MAS), Voluntary Control Grade 2 (VCG) according to Brunnstrom grading, and have had more than a month pass after their stroke. Participants were excluded if they had severe cognitive impairment, thereby could not effectively understand the instructions or if they had any other co-morbidities that would prevent them from effectively doing the exercise or cause other health issues as a side effect. All participants gave informed written consent.

Their demographic details were recorded which included age, sex, type of stroke, time since episode of stroke, number, and address.

The participants were positioned on a chair or their wheelchair and received 30 min of APT cycling (2 min passive warm up, 26 min active cycling and 2 min passive cool down), five days per week for four weeks in addition to conservative treatment approaches.

Outcome measures were assessed the day before and after the four week study period. The primary outcome measure was spasticity and was assessed using Modified Ashworth Scale (MAS). Other outcome measures used were Functional

Independence Measure(FIM) and Fugl-Meyer Assessment for assessing function and Voluntary Control Grading (VCG) used for assessing control over individual joints as well as the limb as a whole.

**RESULT:**

Over the recruitment period 27 people with Stroke came to MGM Institute of Physiotherapy Rehabilitation and Fitness Centre, 13 met the inclusion criteria and they were invited to participate. Three patients declined to participate for various reasons. Ten people were recruited to the study and therefore the resulting data was taken those 10 participants.

Prior to the commencement of the protocol demographic data of all participants were taken. The ages spanned between 30-60, of them 3 were females and 7 males. Of them 8 had MCA stroke, 1 ACA and 1 PCA. (Table no.1)

All adhered to the intervention protocol given with no notable adverse effects. Average scores for all outcome measurements improved after the intervention. (table no.3)

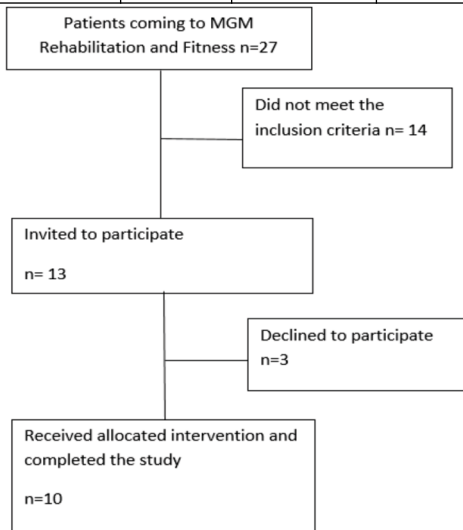
According to MAS, the pre treatment score for all the patients was 1+, after the proposed treatment duration 8 patients showed decrease in spasticity and 2 patients showed no change. On average the participants reported a decrease in spasticity which was shown to be significant over time (p = 0.002).

In terms of FIM, the average pre treatment and post treatment scores showed great improvement (Table no.2). There was a significant increase in total score over time (p < 0.0001). And in regards to Fugl-Meyer Assessment the average pre treatment value was 39.6 and the average post treatment value was 54.8. All patients demonstrated greater functional capacity over time (p<0.0001).

Improvements were also seen in VCG, the pre treatment scores for all the patients were grade 2 and post treatment 5 patients were grade 3 and the other 5 patients were grade 4. All patients demonstrated significantly greater voluntary control over time (p <0.0001).

**Table no.1 Summary of participant demographic variables.**

	Mean	Standard deviation	Coefficient of variation
Age	48.30	10.68	22.11%
Gender	5.000	2.828	56.57%
Type of stroke	3.333	4.041	121.2%
Time since stroke	12.40	3.204	25.84%



**Recruitment Flow Chart**

**Table no. 2 FIM scores pre and post treatment**

FIM score	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No.10
Pretreatment	99	90	97	95	94	88	100	99	96	91
Posttreatment	104	95	107	104	97	96	109	110	104	108

**Table no.3 Summary of outcome measures**

Outcome measures	Pre treatment	Post treatment
FIM	94.9 ± 4.121	103.4 ± 5.541
VCG	2 ± 0	3.5 ± 0.527
MAS	1.5 ± 0	1.1 ± 0.21
FM-LE	39.6 ± 45.97	54.8 ± 59.3

All values mean ± SD

**DISCUSSION:**

The study showed that persons with stroke can benefit from an APT exercise regimen on an outpatient basis. The bulk of outcome measures showed improvements. Additionally, there was complete compliance with the cycling intervention, and there were no reported side effects, demonstrating its acceptability as a therapeutic choice.

**1. Spasticity**

Before starting the treatment each patient was tested for spasticity. Grading was done using MAS scale and all patients exhibited a score of 1+. Post treatment they were again checked for spasticity and out of the 10 patients 8 had a score 1 and 2 patients retained their score of 1+. Though there were minor changes noted by the participants, when the comparison was done between the pre and post values the result was shown to be significant over time (p=0.002).

In a study conducted by Lo HC et al it is found that assisted cycling has a positive effective on reducing spasticity.<sup>12</sup>

Another study conducted by CY Yeh et al to evaluate whether a bout of leg cycling in patients with stroke reduces muscle tone proved that the hypertonia of patients with stroke showed a significant decrease immediately after a bout of leg-cycling exercise.<sup>13</sup>

The lack of an objective improvement in spasticity could be attributed to the outcome measure used. Despite being the most commonly used test of spasticity, the MAS only measures passive resistance or limb stiffness. Thereby more specific tests should be employed to test the changes in spasticity.

**2. Function**

During this study the patients filled out the FIM scale and FM-LE as a measure of functionality. This was done twice, once at the start of the therapy protocol and once the set duration was over. The patients displayed increase in the overall scores. This proved that they had taken a step towards transitioning from moderate independence to full independence.

When the comparison was done between the pre and post values the result was significant. In terms of FM-LE the value was p<0.0001 and for FIM scale the result was p<0.001 thereby by both accounts there is good prognosis.

In a study conducted by da Rosa Pinheiro et al it is said conventional physiotherapy combined with cycling exercise showed better results in the improvement of muscle strength of lower limbs, mobility and functionality of subjects who suffered from acute stroke.<sup>14</sup>

The participants have shown improvement in their activities of daily living and have claimed a higher level of independence. In another study done by Barbosa D et al claimed that the application of cycling leg exercise alone and combined with feedback in stroke rehabilitation approaches has shown promising results. Positive effects on motor abilities were

found in subacute and chronic patients.<sup>15</sup>

In regards to specificity and accuracy of measurements the Fugl-Meyer Lower limb assessment has shown to be a better tool for precise data assembly than the functional Independence Measure scale which though measures functionality covers more broader aspects than give detailed assessment.

### 3. Voluntary Control

Prior to the intervention the patient's level of voluntary control was noted using VCG given by Brunnstrom. All the patients had a pre treatment grade of 2. After treatment 5 patients had grade 3 and the other 5 had grade 4. Overall the patients showed remarkable increase in voluntary control over the affected lower limb.

When the comparison was done between the pre and post values the result was significant. The participants portrayed better control over the affected limb.

In a study conducted by C Vanroy et al Implications for Rehabilitation The active cycling program combined with education is applicable in subacute stroke patients as it produces significant results in patients with severe motor deficits.<sup>16</sup>

The voluntary control grading scale is in accordance with the brunnstrom stages of recovery and grossly charts the recovery phases of the affected limb. To exactly map the control exerted by the patient over the limb we should employ tests that are more sensitive to these changes.

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### Author Contributions:

1. Ayesha Fatima Mohammad Salahuddin - study design, participant recruitment, administration of intervention, result analysis
2. Gaurav C Mhaske - study design, formulation of result and discussion,

### Summary for Social Media If Published

Studies have shown that Active Passive Trainer used as an adjunct to cycling has good prognosis. This study tests the effect of cyclic motions alone with some help from immediate feedback. The results from this study will thereby help to create more personalized treatment protocol and add more treatment approach prospects.

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