

Progressive resistance training improving gait performance and mobility in acute and chronic stroke patients

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Abstract

Stroke, a neurological disorder, leads to long-term disability thereby greatly affecting gait and mobility. The purpose of the current study was to investigate the effects of progressive resistance training in both acute and chronic stroke patients. A quasi interventional study was designed and 46 stroke patients were recruited through convenience sampling technique. Sample size was calculated using epi-tool. Patients who had cognitive problems, balance impairments and contractures were excluded from the study. The study was conducted from January to June 2018, at Rafsan Rehab & Research Centre, Peshawar. Progressive resistance exercises starting at 50 % of one repetition maximum (RM) were performed three days/week and for a total duration of nine weeks. Blind assessor measured readings at baseline and after nine weeks. Gait dynamic index (GDI), Six-Meter Walk Test (SMWT) and Five Times Sit-to-Stand (FTSTS) tools were used to collect the required data. The data was analysed at baseline and after nine weeks on SPSS-20. After nine weeks of intervention significant improvement was recorded in patients on GDI ($p < 0.001$), SMWT score ($P < 0.001$) and FTSTS ($p < 0.001$). Progressive resistance training improves mobility limitations and gait in both acute and chronic stroke patients.

Keywords: Balance, Gait, Mobility Limitation, Resistance Training, Stroke

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Introduction

Walking independently denotes a life-enriching ability in the course of one's daily life.¹ Stroke commonly affects walking ability along with other impairments in gait parameters; hence, restoring an optimal gait performance marks one of the major goals of stroke rehabilitation.² Kim et al in their study states that exercises that predominantly increase muscle strength of lower extremities in stroke

patients have shown significant improvements in gait and stair-climbing function, particularly by enhancing force generation through larger range of motion.³

Several factors are associated with typical gait abnormalities in individuals after a stroke including decreased velocity, impaired postural and joint control, asymmetry of stride length and time, lower limb muscle weakness, impaired muscle tone and other related factors. Among all, muscle weakness contributes greatly and is a common impairment in stroke patients leading to impaired gait performance. Both the ability and quality of walk is strongly associated and relies on strength of the lower extremity muscles. Optimal stroke rehabilitation necessitates improving patient's gait performance and requires restoring muscle strength of lower extremities.⁴ Numerous researchers suggest resistance training for lower limb muscles in order to improve the ability to walk in stroke patients. Wenwen H.E. in a recent randomised control trial reports resistance training to be effective in improving gait.⁵ Similar results have been reported by some meta-analyses as well.^{6,7} However a systemic review evaluating resistance training reported that improved strength in stroke patients does not necessarily affect their ability to walk.⁸

Functional restoration in stroke patients along with other chronic diseases can be achieved by resistance training. Yet literature lacks evidence regarding studies conducted in Pakistan. The current study was aimed to evaluate the effectiveness of strength training in acute and chronic stroke patients in terms of gait improvement.

Methods and Results

A quasi experimental study with a sample of 46 stroke patients of either gender was conducted to observe the effect of progressive resistance training on gait. There was only a single experimental group without randomisation and no control group. The experiment was conducted at the Rafsan Rehab Centre, Peshawar, from January to June 2018. Epi-tool was used to measure the sample with 4.9 standard deviation, 0.95 confidence level and desired precision 1.5.⁹ Patient recruitment was based on non-probability purposive sampling technique and inclusion criteria: 46 stroke patients with a minimum 24 score on mini mental state examination, able to follow three step

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Table-1: Intervention / Progressive Resistance Strength Training.

Muscle Groups	Concentric, Eccentric and Isometric Exercises
Flexors, Extensors & Abductors (Hip)	3 Sets of 10 Repetitions
Flexors & Extensors (Knee)	3 Sets of 10 Repetitions
Planter Flexors & Dorsi Flexors (Ankle)	3 Sets of 10 Repetitions

Table-2: Across & between groups Analysis for Dynamic Gait Index.

Group	Acute Stroke		Chronic Stroke		p-value
	Mean ± SD	Mean Rank	Mean ± SD	Mean Rank	
Across Group Analysis for Dynamic Gait Index					
Baseline	6.66 ± 2.35	13.44	9.00 ± 2.09	23.56	<0.004
Post Intervention	18.27 ± 2.05	15	19.7 ± 1.96	22	<0.043

Group	Baseline		Post Intervention		p-value
	Mean ± SD	Mean ± SD	Mean Rank	p-value	
Within Group Analysis for Dynamic Gait Index					
Acute Stroke	6.66 ± 2.35	18.27 ± 2.05	9.5	<0.001	
Chronic Stroke	9.00 ± 2.09	19.7 ± 1.96	9.5	<0.001	

Table-3: Across & between groups Analysis for 6 Minute Walk Test & 5 Times Sit to Stand Test.

Group	Acute Stroke		Chronic Stroke		p-value
	Mean ± SD	Mean Rank	Mean ± SD	Mean Rank	
Across Group Analysis for 6 Minute Walk Test					
Baseline	35.77 ± 14.52	9.86	84.16 ± 20.02	27.14	<0.001
Post Intervention	76.50 ± 12.64	10.56	155.6 ± 50.61	26.44	<0.001

Group	Baseline		Post Intervention		p-value
	Mean ± SD	Mean ± SD	Mean Rank	p-value	
Within Group Analysis for 6 Minute Walk Test					
Acute Stroke	35.77 ± 14.52	76.5 ± 12.64	9.5	<0.001	
Chronic Stroke	84.16 ± 20.02	155.6.7 ± 50.61	9.5	<0.001	

Group	Acute Stroke		Chronic Stroke		p-value
	Mean ± SD	Mean Rank	Mean ± SD	Mean Rank	
Across Group Analysis for Five Times Sit to Stand Test					
Baseline	73.9 ± 24.85	23.28	53.55 ± 13.62	13.72	<0.006
Post Intervention	34.96 ± 12.56	24	23.22 ± 7.03	13	<0.002

Group	Baseline		Post Intervention		p-value
	Mean ± SD	Mean ± SD	Mean Rank	p-value	
Within Group Analysis for Five Times Sit to Stand Test					
Acute Stroke	73.9 ± 24.85	34.96 ± 12.56	9.5	<0.001	
Chronic Stroke	53.55 ± 13.62	23.22 ± 7.03	9.5	<0.001	

command and age above 30 years. Patients who did not meet the criterion or those who had some other problems such as inflammatory joint problems, cognitive impairments, severe visual impairments, trauma, contractures, fractures or unstable and uncontrolled diabetes or hypertension were excluded. Informed consent form was signed by all the patients. The study was approved by Riphah Ethical Committee. The patients received intervention three days/week and for a total duration of nine weeks with progressive increase in resistance (started at 50 % of 1 RM and increased to 60%

and 70%, respectively every three weeks). Blind assessor measured readings at baseline and after nine weeks. Final analysis was done using SPSS 20, for 39 participants after 7 patients dropped out.

Both the categories of stroke patients, i.e. acute and chronic, received the same treatment intervention with equal intensity and repetitions. Treatment was given for nine weeks (three days/week) and time for each session was 45 minutes. Resistance was initiated at 50 % of 1 Repetition Maximum and was increased to 60% and 70% for every three weeks, respectively. Major muscle groups targeted for strength training are listed in Table 1. Along with strength training patients also performed squatting, walk in parallel bar and sit-to-stand activity (10 repetitions, 3 sets). Assessment tools included Six-Minute Walk Test, Dynamic Gait Index and Times Sit-to-Stand Test.

Test of Analysis were non-parametric test and were selected on the basis of test of normality (ShapiroWilk test- $p > 0.05$). The sample included 12 (30.8 %) females with a mean age of 57.42 ± 7.74 years and 27 (69.2%) males with a mean age of 57.93 ± 10.02 years. Twenty (51.3%) participants who had stroke less than three months ago were in the acute stroke category, whereas 19 (48.7%) were in chronic stroke category. The mean age of acute and chronic stroke participants was 57.80 ± 9.57 years and 57.74 ± 9.22 years, respectively.

Significantly improved result with p -value 0.001 was observed in both acute and chronic stroke patients before and after the treatment, whereas there was no difference in the effect of intervention among the two categories.

Like Gait Dynamic Index significant improvement was also measured with P value 0.001 in both acute and chronic stroke patients before and after treatment for Six-Minute Walk Test and five Times Sit-to-Stand Test (Table 2). Looking at the mean rank slightly greater effect was observed in 6 Six-Minute Walk Test and five Times Sit-to-Stand Test for chronic stroke patients.(Table 3)

Discussion

The current study investigates the effects of progressive resistance training in stroke patients. The sample size of this study was 39 patients. Out of the 39 patients included in the final analysis, 0-3 months passed since stroke attack in 19 patients, and in the remaining 20 patients more than 3-

4 months had passed since the stroke. The study showed that progressive resistance training can improve gait in stroke patients after receiving nine weeks of progressive resistance training. It also showed improvement in all the three outcome tools, i.e. Gait Dynamic Index, Six-Minute Walk Test and Five Times Sit-to-stand test. A systemic review published recently also support the use of progressive resistance training for improving function, mobility and gait in stroke survivors.⁶ Resistance training can improve the functional limitations and improves strength in both paretic and non-paretic lower limb.⁹

However, a study conducted in 2008 in Sweden on progressive resistance training in stroke patients reported that after 10 weeks of intervention in chronic stroke patients no immediate effect was measured in gait performance,¹⁰ whereas in the current study gait performance improved in both acute as well as chronic stroke patients. Another study published in 2017 also supports the effectiveness of progressive resistance training in stroke patients to improve gait performance. This study assessed the short-term and long-term effects of resistance training in stroke patients.¹¹

Conclusion

Findings of the study show that not only acute stroke survivors but also chronic stroke patients have the capacity to improve gait related functional outcomes by improving strength of the lower limbs. The effects of progressive resistance training on both acute and chronic stroke patients are equally effective. However, further studies especially randomised controlled trials should be conducted to further investigate the effects of progressive resistance training.

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