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

29   (P<0.001), SMWT score (P<0.001) and FTSTS (P<0.001). Progressive

30   resistance training improves mobility limitations and gait in both acute and

31   chronic stroke patients.

32   **Key Words:** Balance,Gait,Mobility Limitation**,** Resistance Training, Stroke

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34   **Introduction**

35   Walking independently denotes a life-enriching ability in the course of one's

36   daily life.[1] Stroke commonly affects walking ability along with other

37   impairments in gait parameters; hence, restoring an optimal gait performance

38   marks one of the major goals of stroke rehabilitation.[2] Kim et al in their study

39   states that exercises that predominantly increase muscle strength of lower

40   extremities in stroke patients have shown significant improvements in gait and

41   stair-climbing function, particularly by enhancing force generation through

42   larger range of motion.[3]

43   Several factors are associated with typical gait abnormalities in individuals after

44   a stroke including decreased velocity, impaired postural and joint control,

45   asymmetry of stride length and time, lower limb muscle weakness, impaired

46   muscle tone and other related factors. Among all, muscle weakness contributes

47   greatly and is a common impairment in stroke patients leading to impaired gait

48   performance. Both the ability and quality of walk is strongly associated and

49   relies on strength of the lower extremity muscles. Optimal stroke rehabilitation

50   necessitates improving patient's gait performance and requires restoring muscle

51   strength of lower extremities.[4]

52   Numerous researchers suggest resistance training for lower limb muscles in

53   order to improve the ability to walk in stroke patients. Wenwen H.E. in a recent

54   randomised control trial reports resistance training to be effective in improving

55   gait.[5] Similar results have been reported by some meta-analyses as well.[6, 7]

56   However a systemic review evaluating resistance training reported that

57 improved strength in stroke patients does not necessarily affect their ability to
58 walk.[8]

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

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65 **Methods and Results**

66 A quasi experimental study with a sample of 46 stroke patients of either gender
67 was conducted to observe the effect of progressive resistance training on gait.
68 There was only a single experimental group without randomisation and no
69 control group. The experiment was conducted at the Rafasan Rehab Centre,
70 Peshawar, from January to June 2018. Epi-tool was used to measure the sample
71 with 4.9 standard deviation, 0.95 confidence level and desired precision 1.5.[9]
72 Patient recruitment was based on non-probability purposive sampling technique
73 and inclusion criteria: 46 stroke patients with a minimum 24 score on mini
74 mental state examination, able to follow three step command and age above 30
75 years. Patients who did not meet the criterion or those who had some other
76 problems such as inflammatory joint problems, cognitive impairments, severe
77 visual impairments, trauma, contractures, fractures or unstable and uncontrolled
78 diabetes or hypertension were excluded. Informed consent form was signed by
79 all the patients. The study was approved by Riphah Ethical Committee. The
80 patients received intervention three days/week and for a total duration of nine
81 weeks with progressive increase in resistance (started at 50 % of 1 RM and
82 increased to 60% and 70%, respectively every three weeks). Blind assessor
83 measured readings at baseline and after nine weeks. Final analysis was done
84 using SPSS 20, for 39 participants after 7 patients dropped out.

85 Both the categories of stroke patients, i.e. acute and chronic, received the same

86 treatment intervention with equal intensity and repetitions. Treatment was given

87 for nine weeks (three days/week) and time for each session was 45 minutes.

88 Resistance was initiated at 50 % of 1 Repetition Maximum and was increased to

89 60% and 70% for every three weeks, respectively. Major muscle groups

90 targeted for strength training are listed in Table 1. Along with strength training

91 patients also performed squatting, walk in parallel bar and sit-to-stand activity

92 (10 repetitions, 3 sets). Assessment tools included Six-Minute Walk Test,

93 Dynamic Gait Index and Times Sit-to-Stand Test.

94 Test of Analysis were non-parametric test and were selected on the basis of test

95 of normality (ShapiroWilk test- $p > 0.05$). The sample included 12 (30.8 %)

96 females with a mean age of 57.42 ± 7.74 years and 27 (69.2%) males with a

97 mean age of 57.93 ± 10.02 years. Twenty (51.3%) participants who had stroke

98 less than three months ago were in the acute stroke category , whereas 19

99 (48.7%) were in chronic stroke category. The mean age of acute and chronic

100 stroke participants was 57.80 ± 9.57 years and 57.74 ± 9.22 years, respectively.

101 Significantly improved result with P value 0.001 was observed in both acute and

102 chronic stroke patients before and after the treatment, whereas there was no

103 difference in the effect of intervention among the two categories.

104 Like Gait Dynamic Index significant improvement was also measured with P

105 value 0.001 in both acute and chronic stroke patients before and after treatment

106 for Six-Minute Walk Test and five Times Sit-to-Stand Test.(Table 2) Looking at

107 the mean rank slightly greater effect was observed in 6 Six-Minute Walk Test

108 and five Times Sit-to-Stand Test for chronic stroke patients.(Table 3)

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Discussion

111 The current study investigates the effects of progressive resistance training in

112 stroke patients. The sample size of this study was 39 patients. Out of the 39

113 patients included in the final analysis, 0-3 months passed since stroke attack in

114 19 patients, and in the remaining 20 patients more than 3-4 months had passed
115 since the stroke. The study showed that progressive resistance training can
116 improve gait in stroke patients after receiving nine weeks of progressive
117 resistance training. It also showed improvement in all the three outcome tools,
118 i.e. Gait Dynamic Index, Six-Minute Walk Test and Five Times Sit-to-stand
119 test. A systemic review published recently also support the use of progressive
120 resistance training for improving function, mobility and gait in stroke
121 survivors.[6] Resistance training can improve the functional limitations and
122 improves strength in both paretic and non-paretic lower limb.[9]

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

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132 **Conclusion**

133 Findings of the study show that not only acute stroke survivors but also chronic
134 stroke patients have the capacity to improve gait related functional outcomes by
135 improving strength of the lower limbs. The effects of progressive resistance
136 training on both acute and chronic stroke patients are equally effective.
137 However, further studies especially randomised controlled trials should be
138 conducted to further investigate the effects of progressive resistance training.
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183   **Table 1: Intervention / Progressive Resistance Strength Training**

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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

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189 **Table 2: Across & between groups Analysis for Gait Dynamic Index**

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Across Group Analysis for Gait Dynamic Index (GDI)					
	Acute Stroke		**Chronic Stroke**		
Group	Mean ± SD	Mean Rank	Mean ± SD	Mean Rank	P - Value
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
Within Group Analysis for Gait Dynamic Index (GDI)					
	Baseline		**Post Intervention**		
Group	Mean ± SD	Mean ± SD	Mean Rank	P-value	
Baseline	6.66 ± 2.35	18.27 ± 2.05	9.5	<0.001	
Post Intervention	9.00 ± 2.09	19.7 ± 1.96	9.5	<0.001	

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194 **Table 3: Across & between groups Analysis for 6 Minute Walk Test & Five**
195 **Times Sit to Stand Test**
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Across Group Analysis for 6 Minute Walk Test					
Acute Stroke			Chronic Stroke		
Group	Mean ± SD	Mean Rank	Mean ± SD	Mean Rank	P - Value
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
Within Group Analysis for 6 Minute Walk Test					
Baseline			Post Intervention		
Group	Mean ± SD	Mean ± SD	Mean Rank	P-value	
Baseline	35.77 ± 14.52	76.5 ± 12.64	9.5	<0.001	
Post Intervention	84.16 ± 20.02	155.6.7 ± 50.61	9.5	<0.001	
Across Group Analysis for Five Times Sit to Stand Test					
Acute Stroke			Chronic Stroke		
Group	Mean ± SD	Mean Rank	Mean ± SD	Mean Rank	P - Value
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
Within Group Analysis for Five Times Sit to Stand Test					
Baseline			Post Intervention		
Group	Mean ± SD	Mean ± SD	Mean Rank	P-value	
Baseline	73.9 ± 24.85	34.96 ± 12.56	9.5	<0.001	
Post Intervention	53.55 ± 13.62	23.22 ± 7.03	9.5	<0.001	

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