



EFFECTIVENESS OF STRENGTHENING EXERCISES IN IMPROVING FUNCTIONAL ACTIVITIES OF HEMIPLEGIC PATIENTS


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ABSTRACT

Background of the Study: To determine the Effectiveness of Strengthening (Resistance) exercises in improving functional activities such as gross motor function and walking stance in stroke patients.

Methodology: A Quasi experimental study was conducted. A Quasi experimental study was conducted; patients were selected from the OPD setting of Dr. Ziauddin Hospital, Saifee Hospital and the National medical center. Data was divided into two groups. Group 1 case and group 2 controls. The patients included in group 1, received Strengthening exercises. While, the other group received exercises other than strengthening such as Balance and Coordination Exercises, Flexibility Exercises, Functional Training and Gait Training, after which their improvement was recorded at the end of 4 weeks for 3 months. The critical outcomes evaluated subsequently to resistance training using therabands and minimal weights along with gait assessment, and functional training. Gait assessment, post-treatment using a 6-minute walk test (6MWT) and functional activities assessment scales using a Barthel Index.

Results: The clinical intervention revealed significant results, showing that strength on the effected side increased post treatment as the calculated P-value was less than 0.05, also the mean leg strength for the RT group (pre walk_ 1.94 and 2.28 for control at baseline improved (post walk _to 2.71 for RT group and 1.60 for controls respectively after 3 months., suggested that resistance training produced marked improvement in performing functional activities of hemiplegic patients.

Conclusions: Hence, it is concluded that the strengthening exercises including resistance band training and physio ball for upper limb and resistance training for lower limb were shown to improve Muscle strength and cause considerable improvement in performing the activities of everyday living and gait strength and core stability in patients suffering from stroke. Also, improving their social interactions and participation in everyday life.

Keywords: *Strengthening exercises, hemiplegia, functional activities, post-stroke hemiparesis, resistance training, flexibility.*

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Citation: Angela C, Adnan QA, Latif D, Jabbar R, Alam B, Tariq I. EFFECTIVENESS OF STRENGTHENING EXERCISES IN IMPROVING FUNCTIONAL ACTIVITIES OF HEMIPLEGIC PATIENTS. Pakistan Journal of Rehabilitation. 2024 July 6;13(2):58–66. Available from: <https://doi.org/10.36283/pjr.zu.13.2/009>

Received: Mon, Feb 13,2023

Accepted: Fri, July 05, 2024

Published: Sat, July 06, 2024

Introduction

Stroke has been marked as the major cause of disability and the third foremost common cause of death in the older Americans¹. Likewise, Pakistan reports an incidence of stroke of about 95 per 100,000 persons per year² expressing weakness in performing everyday activities and lack of muscle strength. The Physiological changes leading to weakness as summarized by Bourbonnais and Vanden Noven and Giuliani included denervation, loss of motor units, type-II muscle fibers atrophy, impaired recruitment of motor units, and decreased contractions as factors contributing to muscular weakness. A study by Burke et al indicated that harmful motor impairments following stroke e.g. loss of Strength, agility, skill resulted in significant disability³. Therefore, it has become a major concern for the patients, families and rehabilitators these days⁴. Hence, rehabilitation following a stroke aims at, making a patient independent in performing gross motor skills, regaining muscle strength, independent walking and improving the activities of daily living⁴. Therefore, Physical exercises such as strength training acquire an essential role, as a primary form of Rehabilitation for patients suffering from stroke, as these exercises considerably aid in improving the activities of daily living, posture and cause a reduction in pain and disability⁵. The significance of exercise and training post stroke has also been documented through various researches^{6,7}. Chronic stroke patients suffer from reduced muscle strength and aerobic capacity^{8,9}. Therefore, it requires work on both motor and functional aspects. Resistance exercises tend to increase muscle strength, tone and performance in athletic and rehabilitation programs^{10,11}. Hence, the incorporation of strengthening exercises into physical rehabilitation programs may aid in counteracting weakness, redeveloping strength and power within muscles and improve overall physical function. Weakness is documented to be the primary impairment in post-stroke patients¹². The Physiological changes leading to weakness in stroke patients summarized by Bourbonnais and Vanden Noven¹³ and Giuliani¹⁴ included denervation, loss of motor units, type-II muscle fibers atrophy, impaired recruitment of motor units, and decreased contractions as factors contributing to muscular weakness. Some studies indicated that the inappropriate activation of antagonist muscles leads to the impairment in force of prime movers^{15,16}. However, the research conducted by Whitley et al¹⁶, Sahrman and Norton¹⁷ indicated that the lack of electromyographic activity and In-coordination both were the factors responsible for movement impairment rather than antagonist spasticity or contraction. Therefore, weakness is evident in both agonists and antagonists of hemiparetic patients. Iso-metric exercise, iso-tonic exercise, and iso-kinetic exercise are used as resistance exercises to increase muscle strength and built the required muscle power^{18,19}. Several studies reported that strength training has a constructive impact on functional ability²⁰. Progressive resistance strength training utilizes free weights (such as dumbles) exercise machines, or elastic bands to strengthen the weaker muscles. Thus, adjusting the resistance, or weight, according to the person's progress is the key to this type of this exercise, so it could be applied to help older adults gain required strength to carry out everyday activities such as walking, eating, climbing stairs, bathing or doing house related work²¹. Weiss et al²² suggested that strength improved by 68% on the affected side and 48% on the least affected side by evaluating the effects of progressive resistance strength training on the affected and least affected sides simultaneously. A study conducted by Chiung-ju Liu²³ observed, that benefits of physical training produced a considerable improvement in muscle strength was noted a moderate to significant improvement in performing simple activities such as getting up from a chair or climbing stairs and a small but significant improvement in doing complex daily activities, such as bathing or preparing a meal. Thus, The purpose of this study is too observe the Effectiveness of Resistive strengthening exercises through the improvement noticed in functional activities such as walking and gross motor activities as measured at four weeks and the long-term efficacy of this treatment, as measured at six months after discharge in post-stroke patients.

Methodology

Quasi experimental study with the subjects meeting the inclusion criteria are in chronic phase of stroke (post 3 months) and can walk independently without assistance, excluding the patients who cannot walk independently. All the participants are selected from the OPD setting of Ziauddin Hospital, Saifee hospital and National medical center. The study was conducted within 6 months from March 2015 to September 2015. The Sample size is 70, randomly allocated into two groups. Samples are selected through convenience sampling technique. Inclusion Criteria adults aged between 45 and 65 years and above, Single Episode of cerebrovascular event, chronic stage of post-stroke hemiparesis, Resistance training exercises included as a part of therapy, medically stable and no severe comorbidities. Exclusion Criteria more than a single episode of cerebrovascular event, post-stroke hemiparesis in acute stage (less than 30 days post-cerebrovascular event), Spasticity with definite synergy patterns and rehabilitation protocol that Includes, constraint-induced therapy were excluded from the study. Intervention details; Experimental group receiving Resistance strengthening exercises were performed using a therabands and minimal weights for shoulder flexors and extensors, elbow flexors and extensors and wrist flexors and extensors, Physioball for grip strength and quadriceps drills using ankle weights for strengthening the quads, along with these isometric exercises were included targeting hip flexors and extensors, abductors and adductors and dorsiflexors and planterflexors. Ending it with gait training sessions including tandem stance and resistive walking using ankle weights²⁴. Stretching exercise sessions were also added as cool down lasting for 30 min at the end of each session. All these exercises were performed in functional ranges with 10-12 repetitions each, two times a day, 3 days a week, supervised by Physical therapist. Improvement was recorded at the end of three months and after six months. Control group was given Conventional physiotherapy treatment including active range of motion exercises, and other exercises such as, Balance training Exercises, single leg standing, Sit to Stand, core strengthening and reaching activities were performed. There are several methods for collecting Data but, we used functional activity assessment form and 6MWT for gait. The outcomes of the study critically evaluated at the end of the each session post treatment and at the end of study. Following resistance training included gait assessment post-treatment, using Walking endurance test, 6-minute walk test (6MWT) and functional activities Assessment scales using Barthel Index (ADL). Data is analyzed using SPSS version 20, results compared using paired t-test.

Results

Eighty Individuals were evaluated for the study, of which 70 subjects were selected, 35 males and 35 females aged 45 to 85 years. Among the selected participants, 35 were marked as strengthening group (study group) and 35 as non-strengthening group or (control group). Strengthening or resistance group received resistance training for 3 months while the control group received conventional treatment other than strengthening exercises. Both groups were evaluated post-treatment to check the degree of improvement in performing functional activities, still no Significant difference found between group was recorded.

		frequency	Percentage
Effected side	Right	31	51.70%
	Left	29	48.30%
Effected limb	Upper limb	29	48.30%
	Lower limb	31	51.70%
Cause	Infraction	47	78.30%
	Hemorrhage	13	21.10%

Table 01. Baseline Characteristics

	Group	N	Mean	Standard deviation
Distance covered/minute	Strengthening group	35	1.94	0.725
	Non strengthening group.	35	2.28	0.737
Distance covered/minute	Strengthening group	35	3.71	0.893
	Non strengthening group	35	2.6	0.577

Table 02: 6-minute walk time

The mean leg strength for the RT group (pre-walk_1.94 and 2.28 for control at Baseline improved (post-walk to 2.71 for the RT group and 1.60 for controls respectively, after three months. Self-Reported Function: Functional outcomes were evaluated using the Barthel Index consisting of (0-10) components, .i.e. feeding, grooming, bathing, dressing, toilet use, bowel and bladder dysfunction, mobility, transfer, and climbing stairs. The scores were rated from (0-10) and were subsequently summed to represent the Improvement in performing the activities of daily living post-treatment. There were no significant differences observed at the baseline, regarding any Functional performance based measure .However, Functional activities improved significantly in the RT group for all muscle groups. Feeding improved by 58.3%in the strengthening group(P_0.001),and 49.7%in the non- strengthening group(P_0.001).dependent bathing enhanced by 52.8%in the RT group and 47.2%in Non-RT group(P_0.001).Similarly patients requiring help for personal care in the RT group enhanced to 51%and 49%in Non-RT group(P_0.001) patients requiring support for dressing enhanced by 68.3%in the RT group and 31.7% in NRT, while the patients remaining dependent for dressing were 29.4%.After strengtheningand70.6% in non-strengthening group (P_0.001).There was No considerable difference for incontinent bladder or bowel; However Occasional accident for bowel improved to 60.5%in RT group and 39.5%in the NRT group While the occasional accidents for the bladder improved to 56.4%in the RT group and 43.6% in the NRT group. Similarly, the continent bowel improved to 55.6%in the RT group and 44.4% in the NRT group. Whereas, the continent bladder improved by55.6%in the RT Group and 44.4%in NRT group (P_0.001) transfers requiring immense help, improved by44.8%in the RT group and 55.2%in the NRT group, while transfers that needed minor help enhanced by15.2%in the RT group and 4.8%in the NRT group (P_0.001).Likewise, mobility for wheelchair-bound patients improved by 42.3%for RTgroupand57.7%for the NRT group (P_0.001).Similarly stair activities for unable patients improved by 42.1% in the RT group and 57.9% in the NRT group and stair activities for patients requiring help or physical aid improved by 86.4% in the RT group and13.6%in the NRT group(P_0.001).

Discussion

These results indicate positive outcomes of the study, representing an increase in muscle strength with resistive exercises without a raise in muscle tone. A Recent review by Ada etal²⁵, showed evidence that the strengthening Intervention in chronic post-stroke patients increased by 0.18 SD, whereas our study revealed a much higher increase of 0.725 SD at the end of three months, and 0.893 SD at the end of six months. Thus, suggesting the strengthening programs to be an effective part of rehabilitation post-stroke as such patients suffer from muscle weakness and immobility that may lead to spasticity causing significant difficulty in performing daily task. There are a number of studies regarding strength training in stroke patients. Still, no other study reported previously, concerning resistance training consisted of a control group having the same exercise regime without resistance. Moreland et al²⁶ in a study suggested that, post-stroke long-term benefits of strength training are experienced in patients undergoing strengthening exercises with resistance as compared to training without resistance. Hence our study specially focuses on the resistance training exercises in stroke patients that have yet not been emphasized in previously and focuses on their performance and execution. Past researches, also emphasized on the benefits of

progressive resistance strength training; and aerobic exercise over chronic stroke patients, indicating a considerable improvement in their self-reported functions up to 102% on 6MWT and the 10MWT. Thereby, proving the effects of focused therapy on functional outcomes seen and observed carefully, as illustrated in our study^{27,28}. Although several other studies of stroke patient by Engard et al, Sharp et al and Weiss et al^{29, 30, 31} have indicated, an increase in muscle strength with resistance exercises, still showed no improvement in the performance of the activities of daily living after resistance training exercises was noticed. Therefore, the main focus of our study was to enhance the functions of Daily living activities by, applying the strength resistive training to both upper and lower limb muscle groups. As suggested by, Bale and Strand³² and Jorgensen et al³³ that, Progressive Resistance training in chronic stroke patients may cause improvements in lower Extremity function, and significantly enhance gait speed in performing 6 MWT test. Moreover, this improvement reduces physical Disablement and an individual's ability to walk independently and confidently. Similarly, another recent study by Hye joe jean et al³⁴ demonstrated that, faster walking speed can be achieved in patient with stroke undergoing with strengthening exercises. It also improves functional stability and balance. A study by M Iosa et al³⁵ indicated Quantitative assessment and Improvement in the speed of Walking, gait stability, and endurance. Rehabilitation permits patients to walk in a functional and safer way avoiding risk of disability and fall. As illustrated in our study through table.1. A recent study³⁶ concluded that, activity participation in adults with limited mobility may also enhance with improved gait and reduce fall. Hence, the Goal of our study is centered on improving the weakness through resistance training which showed considerable increase in velocity depicted through 6-minute walk time noticed within the groups signifying that an increase in activity level may produce minor ,but substantial effects on gait performance making the walk more stable and independent. Additionally, a study by Koshiro Haruyama³⁷ et al also emphasized that core strengthening incorporated with other resistance training can cause a considerable improvement in pelvic floor stability, back muscle strength and hence improve balance and mobility. Highly essential in post stroke as the weakness persisting after stroke may lead to the loss of independence and balance causing a lot fall incidences and fractures and lack of self-esteem in stroke patients. Likewise, David et al³⁸ suggested that, the capability to walk safely at a functional speed would lead to the improvement in the quality of life of individuals' post-stroke. Thereby, encourage a significant participation with their family and community. Still, did not specify the type of training approach suitable enough to bring about such noticeable outcomes. However, Our study not only determine the treatment approaches in the form of resistance training but also emphasized the Improvement shown in the patients, evident through 6 minute walk test that may lead to considerable improvements in performing functional tasks of daily living. Impairments such as leg weakness, instability, sensory loss, visual problems, and continence and balance problems may increase the risk of falls. In Accordance, to a study presented by Aidar et al³⁹. Strength training is manifested as a key in reducing fear or stress in people with disabilities and Functional limitations and showed a decrease in ($P \leq 0.05$) in anxiety and fear from pre-to post tests for experimental group as compared to a control Group. Thereby increasing confidence and social and emotional stability among post stroke patients. These results approve the findings in our study, indicating the improvements in social and emotional stability of patients undergoing strength training protocols. In Summary, Our results indicate the benefits of resistance training in stroke Survivors, and show how considerable improvement could be achieved using a Resistance training program in functional activities and improving Musculoskeletal strength simultaneously of both the limbs, Paretic and non-Paretic and so these improvements eventually lead to decrease functional limitations, disability and providing independence in performing the activities of daily living. Further studies are required to investigate the effects of Iso-Kinetic strength training and Progressive Resistance Training on functions, Motor impairments, and disability in chronic stroke patients.

Conclusion

Hence, the effects of rehabilitation exercise programs in recovery of physical function in patients with stroke was evident in a review⁴⁰, based on aspects of their physical function, physical strength, and daily activities, the Results indicate that physical and active rehabilitation were obligatory rather than unconditional rest. As suggested by a recent study by Punt et al⁴¹ that lack of gait may lead to deconditioning leading to subsequent risk of fall. Therefore, it is concluded that Strengthening (resistance) exercises versus the non-strengthening protocols produced positive effects on the clinical trial of walking and gross motor functions in stroke survivors undergoing the Rehabilitation process, and did not produce an increase in muscle tone or spasticity resulting from resistance training as previously reported by other studies. Also apart from improving physical abilities and functions it also produced considerable increase in confidence and social wellbeing, thereby reducing depression and adding to life expectancy.

AUTHORS' CONTRIBUTION:

The following authors have made substantial contributions to the manuscript as under:

Conception or Design: Christina Angela, Qurat ul Ain, Danish Latif

Acquisition, Analysis or Interpretation of Data: Bakhtiar Alam, Christina Angela, Danish Latif

Manuscript Writing & Approval: Rameela Jabbar, Christina Angela, Danish Latif, Iqbal Tariq

All authors acknowledge their accountability for all facets of the research, ensuring that any concerns regarding the accuracy or integrity of the work are duly investigated and resolved.

ACKNOWLEDGEMENTS: We thanks all the participants in this study.

INFORMED CONSENT: Written Informed Consent was taken from each patient.

CONFLICT OF INTEREST: The author (s) have no conflict of interest regarding any of the activity perform by PJR.

FUNDING STATEMENTS: None declared

ETHICS STATEMENTS: The study has been approved by the Ethical Board of Riphah international University REF/RIPHAH/RCRS/REC/00181.

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