



Effect of Endurance Training on Long-Term Stroke Survivors

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Abstract

Background: Stroke is one of the leading causes of dependency and mortality in India. Chronic stroke is defined as 6 months to years from the time of onset. Structural impairment which occurs in stroke lead to the complex nature of functional limitations. High blood pressure, diabetes mellitus, blood vessel diseases, and obesity are a few risk factors that can cause stroke. Once the patient goes into the chronic phase, a wide range of problems in functional mobility, gait, and Quality of Life may occur. Majority of times the patient survives their remaining life with these disabilities. The survival rate decreases with an increase in time. Only 1% survive 20 years after stroke. Physiotherapy has shown a positive effect on functional outcomes in acute stroke. Its efficacy should be tried on chronic survivors. **Method:** 36 subjects were included as per the inclusion and exclusion criteria. The treatment protocol was given for 42 days. Pre and post-changes in subjects were analyzed on a modified Barthel index and stroke-specific Quality of Life scale. **Result:** Data was analyzed using the student's t-test. Findings showed significant change in outcome measures interns of mobility and quality. **Conclusion:** Endurance training improves functional mobility and standard of living in chronic stroke survivors.

Keywords: Chronic Stroke, Endurance, Quality of Life (QOL)

1. Introduction

Stroke was defined by World Health Organization as rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin¹. Almost 5.8 million people die from stroke every year. It has been documented as a second cause of death worldwide. In India, the prevalence is also high. Since the past decade, figures are rapidly increasing from 105 to 152/per 100,000 persons, and the overall prevalence ranged from 44.29 to 559/per 100,000 persons in different parts of India². Signs and symptoms after stroke have a varied nature and are different from gender to gender³. The majority of risk factors include high blood pressure, diabetes, hyperlipidemia, obesity etc. Excessive use of oral contraceptive pills could also be a risk factor for stroke⁴. Thus it has a complex range of causes as well as signs and symptoms.

Chronic stroke presents with decreased functional capacity, altered joint integrity, falls due to dominant synergies in upper and lower limbs, decreased coordination etc. This problem directly affects functional mobility. Social and

recreational activities are reduced in most of the survivors. As per the findings of OLS, people with stroke had 4.1% less mental health score, 7.9% less physical health score, 6.9% less health utility, and 7.2% less self-rating of health. After various treatments, there is some improvement in physical Quality of Life, but psychological quality remained low. Studies have shown that in hemorrhagic stroke, there was no improvement in QOL⁵. Functional mobility decline in stroke is mostly due to residual impairments. It comprises Transfer activities, sitting activities, walking, balance etc. Overall mobility is affected due to lack of recovery, increase in spasticity resulting in synergy, lack of exercise, and overall financial burden on the family. The complex nature of stroke makes it difficult for rehabilitation.

The role of physiotherapy in chronic stroke is still a research thrust. It has been shown to significantly improve the quality of movement in acute stroke. Physiotherapy techniques like motor relearning programmes have been shown to improve functional mobility⁶. The challenges in chronic stroke are different that acute ones. The pattern established is difficult to break. In many instances, the plateau stage is reached where interventions won't show much of a difference in outcome. Therefore a variety of approaches are been implemented

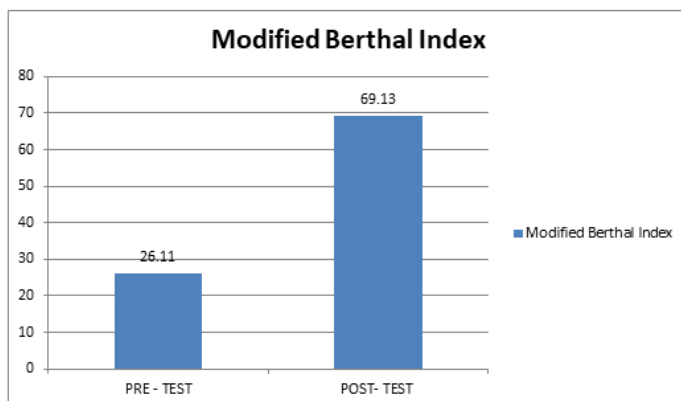
at this stage. A decrease in endurance can result in reduced well-being. It naturally reduces the capacity to move and work for long. Muscles get adapted and become a big barrier to achieving functional independence. The major muscle changes were morphological modifications, variation in muscular metabolism, and electromechanical features⁷. Over a period of time, these changes become permanent making it less responsive to most of the approaches.

2. Materials and Methods

The study commenced after getting ethical approval from the Institutional Ethical Committee of Krishna Institute of Medical Sciences Deemed to be a university, Karad (KIMSUDU/IEC/08/2022). In this experimental study, the effect of endurance training was seen on functional mobility and QOL in chronic stroke survivors. It is a randomized clinical trial with 36 subjects fulfilling the inclusion and exclusion criteria. An inceptive assessment was done on day one. Outcome measures used were the Modified Berthel index for functional mobility and stroke-specific Quality of Life scale for assessing the Quality of Life after stroke. On the initial day, subjects were informed about the treatment, its possible benefits, potential harms, the time period required for each setting, and food timings that were to be followed before and after the treatment. The subjects were told to stop the treatment anytime in between the sessions if they fill any discomfort. The entire treatment duration was for 42 days (6 days/week). Data analysis was done using SPSS software. Student's t-test was used for analysis.

3. Results

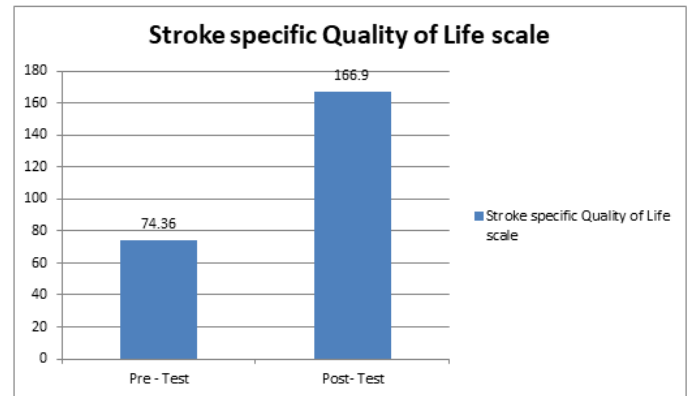
3.1 Modified Berthel Index (After 6 Weeks)



$P < 0.001$ was considered extremely significant $t = 24.836$ and 70 degrees of freedom

Graph 1. Pre and post-test scores of modified Berthel index for functional mobility in chronic Stroke.

3.2 Stroke Specific Quality of Life Scale (After 6 Weeks)



$P < 0.001$ was considered extremely significant $t = 28.25$ and 70 degrees of freedom

Graph 2. Pre and Post test score of Stroke Specific Quality of Life Scale (SS-QOL) for QOL in Chronic stroke.

4. Discussion

Chronic stroke directly or indirectly affects all the systems in the body. The predominantly musculoskeletal and nervous system is largely involved. Community ambulation and cardiovascular fitness are severely compromised⁸. Depression is seen in one-third of chronic stroke survivors⁹. The present study was carried out to see whether endurance training has any effect on it.

4.1 Functional Mobility

Endurance training showed both immediate and short-term effects on mobility. It is well adapted and effective physical activity for older people¹⁰. Activities under endurance training include walking, jogging, swimming, biking and jumping over rope. Such activities are targeted towards breathing and heart rate. They directly activated both tonic as well as phasic muscles which might have influenced the mobility pattern. Consistent practice, mostly of low intensity, polarizing the training, building functional stability and a strong core in endurance training must have directly improved the functional performance in chronic stroke survivors. Circuit-based training has a better effect on gait parameters especially spatial and temporal variables¹¹. Treadmill training has shown better outcomes on gait variables in chronic stroke with hemiplegic gait¹². It has reduced the overaction of quadrates lumborum and established better integration of the spine with lower limbs. Physiologically, endurance exercises increase the mitochondrial content and respiratory capacity of the muscle fibres. This increases the metabolism so that physical tasks

which require longer time could be completed. It reduces fatigability which is very common in older cases. The chances of re-injuries after endurance training are minimum. All these advantages might have directly influenced functional mobility.

4.2 Quality of Life

Most chronic stroke survivors have limitations in their physical activity. Almost 30% of them have depression that significantly affects their Quality of Living¹³. Balance issues and fall risk are also very commonly affected by them¹⁴. Regular endurance training has a direct effect on blood pressure¹⁵ which is considered a major risk factor for stroke. Normal levels of blood pressure have been shown to improve physical performance and Quality of Living. Aerobic exercises are useful in improving aerobic fitness, and speed of walking in subjects with mild to moderate stroke. endurance exercises. Significant changes are been observed in inspiratory muscle strength in chronic subjects. Knee muscle strength is a forecaster of walking ability in chronic mild to moderate hemiparesis¹⁶. Progressive Resistance Exercises (PRE) are effective interventions to improve muscle strength in chronic stroke. Significant changes have been seen when strength training has been added to endurance exercises on Quality of Life even in middle-aged stroke survivors. Task-oriented exercises have been shown to improve walking performances in this subject¹⁷. Endurance training helps in building stamina and thus helps to withstand longer activities. This possibly helps the subjects in carrying out activities of daily living and improves their overall lifestyle.

5. Conclusion

Endurance training has been shown to significantly improve functional mobility and the standard of living in long-term stroke survivors.

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7. References

- Aho K, Harmsen P, Hatano S, Marquardsen J, Smirnov VE, Strasser T. Cerebrovascular disease in the community: Results of a WHO collaborative study. *Bull World Health Organ.* 1980; 58:113–30.
- Kamalakannan S, Gudlavalleti AS, Gudlavalleti VS, Goenka S, Kuper H. Incidence and prevalence of stroke in India: A systematic review. *The Indian Journal of Medical Research.* 2017; 146(2):175. PMID: 29265018 PMCID: PMC5761027. https://doi.org/10.4103/ijmr.IJMR_516_15
- Jhaveri NH, Kanase S. Gender wise difference in presenting signs and symptoms of stroke: Observational study. *Indian Journal of Public Health Research and Development.* 2020; 11(5):270–3.
- Gandhi HM, Kanase SB, Varadharajulu G. Awareness of oral contraceptive pills as a risk factor of stroke. *Journal of Pharmaceutical Negative Results.* 2022; 2783–8.
- Chen Q, Cao C, Gong L, Zhang Y. Health related Quality of Life in stroke patients and risk factors associated with patients for return to work. *Medicine.* 2019; 98(16). PMID: 31008934 PMCID: PMC6494282. <https://doi.org/10.1097/MD.00000000000015130>
- Kanase SB. Effect of motor relearning programme and conventional training on functional mobility in post stroke patients. *Indian Journal of Public Health Research and Development.* 2020; 11(5):496–501.
- Azzollini V, Dalise S, Chisari C. How does stroke affect skeletal muscle? State of the art and rehabilitation perspective. *Frontiers in Neurology.* 2021; 12:797559. PMID: 35002937 PMCID: PMC8733480. <https://doi.org/10.3389/fneur.2021.797559>
- Michael K, Macko RF. Ambulatory activity intensity profiles, fitness, and fatigue in chronic stroke. *Topics in Stroke Rehabilitation.* 2007; 14(2):5–12. PMID: 17517569. <https://doi.org/10.1310/tsr1402-5>
- Srivastava A, Taly AB, Gupta A, Murali T. Post-stroke depression: Prevalence and relationship with disability in chronic stroke survivors. *Annals of Indian Academy of Neurology.* 2010; 13(2):123. PMID: 20814496 PMCID: PMC2924510. <https://doi.org/10.4103/0972-2327.64643>
- Virág A, Karóczy CK, Jakab A, Vass Z, Kovács É, Gondos T. Short-term and long-term effects of nordic walking training on balance, functional mobility, muscle strength and aerobic endurance among Hungarian community-living older people: A feasibility study. *The Journal of Sports Medicine and Physical Fitness.* 2014; 55(11):1285–92.
- Bonini-Rocha AC, de Andrade AL, Moraes AM, Matheus LB, Diniz LR, Martins WR. Effectiveness of circuit-based exercises on gait speed, balance, and functional mobility in people affected by stroke: A meta-analysis. *PM&R.* 2018; 10(4):398–409. PMID: 29111465. <https://doi.org/10.1016/j.pmrj.2017.09.014>
- Kendrick C, Holt R, McGlashan K, Jenner JR, Kirker S. Exercising on a treadmill to improve functional mobility in chronic stroke: A case report. *Physiotherapy.* 2001; 87(5):261–5. [https://doi.org/10.1016/S0031-9406\(05\)60788-2](https://doi.org/10.1016/S0031-9406(05)60788-2)
- Kong KH, Yang SY. Health-related quality of life among chronic stroke survivors attending a rehabilitation clinic. *Singapore Medical Journal.* 2006; 47(3):213.
- Schmid AA, Van Puymbroeck M, Altenburger PA, Miller KK, Combs SA, Page SJ. Balance is associated with Quality of Life in chronic stroke. *Topics in Stroke Rehabilitation.* 2013; 20(4):340–6. PMID: 23893833. <https://doi.org/10.1310/tsr2004-340>

15. Tsai JC, Yang HY, Wang WH, Hsieh MH, Chen PT, Kao CC, Kao PF, Wang CH, Chan P. The beneficial effect of regular endurance exercise training on blood pressure and Quality of Life in patients with hypertension. *Clinical and Experimental Hypertension*. 2004; 26(3):255–65. PMID: 15132303. <https://doi.org/10.1081/CEH-120030234>
16. Flansbjer UB, Downham D, Lexell J. Knee muscle strength, gait performance, and perceived participation after stroke. *Archives of Physical Medicine and Rehabilitation*. 2006; 87(7):974–80. PMID: 16813786. <https://doi.org/10.1016/j.apmr.2006.03.008>
17. Kanase SB, Varadharajulu G. Effect of task related training versus conventional training on walking performances in post stroke patients. *Age (years)*. 2014; 54:53–15.