Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 20s (2025)
https://www.jneonatalsurg.com

Establishment Of Unique Rehabilitation Protocol and Stroke Specific Gymnasium for Post Stroke Individuals

Dr. Suraj Kanase*[1], Dr. Piyusha Jadhav[1], Dr. Neharika Jadhav[1]

[1]Department of Neuro Physiotherapy, Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth, Karad, Maharashtra

***Corresponding Author:**

Dr Suraj B. Kanase

Professor/HOD, Department of Neuro Physiotherapy, Krishna college of Physiotherapy

Email ID: drsurajkanase7@gmail.com

Cite this paper as: Dr. Suraj Kanase, Dr. Piyusha Jadhav, Dr. Neharika Jadhav, (2025) Establishment Of Unique Rehabilitation Protocol and Stroke Specific Gymnasium for Post Stroke Individuals. *Journal of Neonatal Surgery*, 14 (20s), 603-610.

ABSTRACT

Background: Stroke is a leading cause of disability worldwide, with individuals aged 30-40 years being increasingly affected. Effective rehabilitation protocols and specialized gyms can significantly improve outcomes in post-stroke individuals.

Objective: To establish a unique rehab protocol and stroke-specific gym for post-stroke individuals aged 30-40 years and evaluate its effectiveness using the Functional Independence Measure (FIM) and Barthel Index.

Methods: This study recruited 20 post-stroke individuals aged 30-40 years. Participants underwent a 6-week rehab protocol, which included specialized exercises and activities tailored to their needs. Outcome measures were assessed using the FIM and Barthel Index at baseline, post-intervention, and follow-up.

Results: This study of 20 post-stroke individuals (mean age 35.5 ± 3.2 years) showed significant improvements in functional independence and outcomes using a unique rehab protocol and stroke-specific gym. FIM scores improved from 64.5 to 90.5 and Barthel Index scores improved from 55.2 to 80.2.

Conclusion: This study demonstrates the effectiveness of a unique rehab protocol and stroke-specific gym in improving functional independence and outcomes in post-stroke individuals aged 30-40 years. Future studies can build upon these findings to develop more targeted and effective rehabilitation programs

Keyword: *Stroke rehabilitation, post-stroke care, functional independence, Barthel Index, FIM, rehab protocol, stroke-specific gym*

1. INTRODUCTION

Poststroke spasticity (PSS) is a frequent side effect linked to other upper motor neuron syndrome symptoms, such as weakness, lack of coordination, and agonist/antagonist contraction. The term "motor disorder characterized by a velocity-dependent increase in muscle tone and tonic stretch reflexes with exaggerated tendon jerks, resulting from hyperexcitability of the stretch reflex, as one component of the upper motor neuron syndrome" applies to spasticity[1]. PSS is a contributing factor to impairments and disabilities that lead to anomalies in gait, issues with arm usage, and a detrimental effect on functional recovery. As a result, PSS can cause joint contractures, greater discomfort, and a lower quality of life. In clinical practice, reducing muscle hypertonia should be one of the objectives of PSS therapy. The current range of spasticity treatment options is based on the therapeutic approaches for spasticity that are currently accessible are based on both central and peripheral tactics, such as pharmaceutical and surgical therapies, as well as physical techniques to enhance muscle length by stretching. Regarding the latter, there are currently very few efficient rehabilitation methods available to lessen spasticity[2].

Those who suffer from stroke-related hemiparesis often have a noticeable asymmetrical stance and weight bearing, bearing the majority of their body weight through their unaffected lower extremity.Achieving symmetry of weight bearing is a key objective of rehabilitation and fall prevention, and it has been demonstrated that symmetrical stance and weight bearing are predictors of ambulatory capacity[3,4]

According to earlier research, up to 83% of stroke survivors experience balance issues [10]. Following a stroke, these impairments make it difficult to return to work and engage in daily activities, social contacts, and leisure activities[5]. Additionally, after a stroke, balance problems are a major contributor to adverse outcomes, such as a higher incidence of falls , fall-related injuries such fractures , fear of falling , and even death[6]. A year after a stroke, cognitive impairment was also predicted by balance impairment during the acute phase of the stroke, according to a prior study[7,8].

For stroke survivors, integrating balance-focused rehabilitation early in the recovery process can improve functional independence, increase positive outcomes, and ultimately raise quality of life[9]. The need of implementing evidence-based rehabilitation techniques that give balance improvement top priority in stroke care protocols is highlighted by these revelations.

Regaining functional capacity is a major benefit of rehabilitation for stroke survivors. Participating in rehabilitation programs that emphasize muscle-strengthening and balancing training is an important component that has a direct impact on a person's recovery[10,11]. It is crucial to implement a rehabilitation program that include exercises that promote balance because restoring the capacity to walk freely and carry out daily living tasks requires good balance[12].

The energy needs of hemiparetic gait were originally shown to be 55–100% higher than those of normal controls in studies done on stroke patients in the early 1970s, Additionally, it was noted that hemiparetic stroke patients could not comfortably sustain their most efficient walking speed, suggesting that their functional mobility was restricted by low endurance. Deconditioning restricts ambulatory function and may jeopardize gait safety, as seen by the significant activity intolerance shown by senior stroke patients during a 50-yard ambulation exercise. These symptoms included dypsnea, progressive slowness, and reduced motor dexterity.Diminished physiologic fitness reserve is the harmful result of having a low peak exercise capacity and a high energy requirement to carry out daily walking activities.

Along with limb and trunk impairments, people who have had a hemiplegic stroke often exhibit irregularities in their ability to balance in connection to trunk impairment, which is linked to falls and poor balance. In Stroke patients have been shown to exhibit delayed and aberrant postural reflexes in the muscles of their lower extremities in standing. The following are additional postural control issues following a stroke: decreased area of stability in stance, increased sway during quiet standing, delayed and disrupted equilibrium reactions, decreased weight bearing on the paretic limb, and an elevated risk of falling[13].

2. METHODS AND MATERIALS

Study Design

The study was conducted at Krishna Medical College, Krishna Vishwa Vidyapeeth, a tertiary healthcare hospital located in Karad city, Maharashtra. Ethical approval for the study was obtained from the ethical committee of Krishna Vishwa Vidyapeeth. The study included 20 participants diagnosed with stroke, consisting of 10 males and 10 females, aged between 35 and 40 years. Before enrollment, all participants were thoroughly informed about the study procedure, and written informed consent was obtained. A progressive stroke-specific rehabilitation protocol was implemented, with each phase designed to focus on different recovery milestones. This protocol involved the use of a stroke-specific gym, equipped with specialized tools and therapies, to facilitate recovery at each stage, ensuring that participants received targeted support for their rehabilitation needs**.**

Outcome measures :

Functional Independence Measure (FIM):Assesses the individual's level of independence in performing daily activities, including motor and cognitive functions.

Modified Barthel Index (MBI):Measures the degree of assistance required for activities of daily living, such as feeding, dressing, and mobility.

Rehabilitation Stages:The rehabilitation protocol is structured in progressive phases, with each stage building on the previous one:

Acute Phase: Focus on stabilization and basic mobility.

Subacute and Early Recovery Phases: Focus on strengthening, functional training, and mobility improvement.

Late Recovery Phase: Emphasis on gait training, balance, and increasing independence.

Long-Term Health Maintenance: Focus on maintaining long-term health and functional independence.

Impact of Stroke-Specific Gym:The stroke-specific gym is an essential component in each phase of rehabilitation, offering specialized equipment to support strength, mobility, and independence.

Data Collection: Outcome measures (FIM and MBI) were collected at multiple time points throughout the rehabilitation process to track progress and assess the effectiveness of the rehabilitation protocol.

SR NO	STAGES	EQUIPMENTS	EXERCISE	REPETITION
1	FLACCID STAGE	1. Plinth 2. Parallel Bar 3. Leg Press 4. Swiss Ball 5. Stationary Cycling	Passive movement, Bed mobility Sit to stand,Step up-step down Sit with your back and head flat against the seat Sit on Swiss Ball Sit on Cycle	10 X 2 10 X 2 10 X 2 10x2 5 mins
2	SPASTICITY APPEARS	1. Plinth 2. Parallel Bar 3. Leg Press 4. Swiss Ball 5. Arm Ergometer 6. Wrist Mover 7. Stationary Cycling	Stretching,Passive movement, Bed mobility, Weight bearing Sit to stand, Step up-step down, Sit with your back and head flat against the seat Reach outs Sit on Swiss Ball low resistance 3 to 5 mints Flexion and Extension, Supination and Pronation Sit on Cycle	10x2, 10x2, 10x2, 10x2, 10x2 10 X 2 10 reps 5 mins
3	INCREASED SPASTICITY	1. Plinth 2. Foam Roller 3. Parallel Bar 4. Leg Press 5. Swiss Ball 6. Arm Ergometer 7. Wrist Mover 8. Shoulder Pull 9. Ankle Mover 10. Stationary Cycling	Stretching, passive movements, Bed mobility, Rimp (upper/lower), Weight bearing Ask the patient to lie supine on a foam roller along the spine to stretch the chest and biceps. Sit to stand, Step up-step down Sit with your back and head flat against the seat Reach outs Sit on Swiss Ball low resistance 3 to 5 mints Flexion and Extension,Supination and Pronation Hold a resistance band or weight overhead, pull it behind your head, then return to start. Sit on chair .place a foot on a surface of mover Sit on the cycle-slightly increase resistance.	30 sec hold, 10x3 10x3 10x3 10x3 10x2 10x3 10x3 10x2 10x3 10 x 3 5 mins
5	SPASTICITY CONTINUES TO DECREASE	1. Plinth 2. Parallel Bar 3. Leg Press 4. Shoulder Pull	Stretching ,Active assisted exercises,Bed mobility, Rimp upper/lower limb,Side lying to prone,Weight bearing Sit to stand – Reach outs, Marching, Obstacle walking, Squats Sit with your back and head flat against the seat Hold a resistance band or weight overhead, pull it behind your head, then return to start. Grasp the handlebar with both hands, palms down,	30 sec hold 10x3 10x3 10 x 3 10 x 3

		5. Super Rider 6. ADL Table 7. ADL Box 8. Swiss Ball 9. Wrist Mover 10. Rowing Machine 11. Stationary Cycling	and sit on the seat. Finger ladder, Finger pulley Ask the patient to sit on the chair with the ADL box in front. Reach outs,Reach outs of unaffected side, Flexion and Extension, Supination and Pronation Push feet against footrest, extending legs. Sit on the cycle-slightly increase resistance.	10 x 3 10 x 3 10 x 3 10x3 10x3 10x3 5 mins
6	SPASTICITY DISAPPEARS	1. Plinth 2. Parallel Bar 3. Leg Press 4. Shuolder Pull 5. Super Rider 6. ADL Table 7. Swiss ball 8. Wrist mover 9. Rowing Machine 10. Stationery Cycling 11. Quadriceps table 12. Ankle mover 13. Treadmill	Active movement, Bed mobility,Reach outs, Kneel walking, Kneel sit to stand ,Weight bearing Sit to stand, Marching, Obstacle walking, Squats, Side walking Sit with your back and head flat against the seat Hold a resistance band or weight overhead, pull it behind your head, then return to start. Grasp the handlebar with both hands, palms down, and sit on the seat. Finger ladder, Finger pulley Ask the patient to sit on the chair with the ADL box in front Reach outs,Reach outs of unaffected side, Flexion and Extension, Supination and Pronation Push feet against footrest, extending legs. Sit on the cycle-slightly increase resistance. Sit on the table, back against the backrest, and secure your ankles in the attachment. Sit on a chair, place a foot on a surface, point your toes away, then flex them back towards your shins. Stand on the treadmill, step onto the belt, and walk, dragging the belt back with each step.	10 x 3 10 x 3 10 x 3 10 x 3 10 x 3 10 x 3 1o x 3 10 x 3 10 x 3 10 x 3 10 x 3 10 x 3 5 min

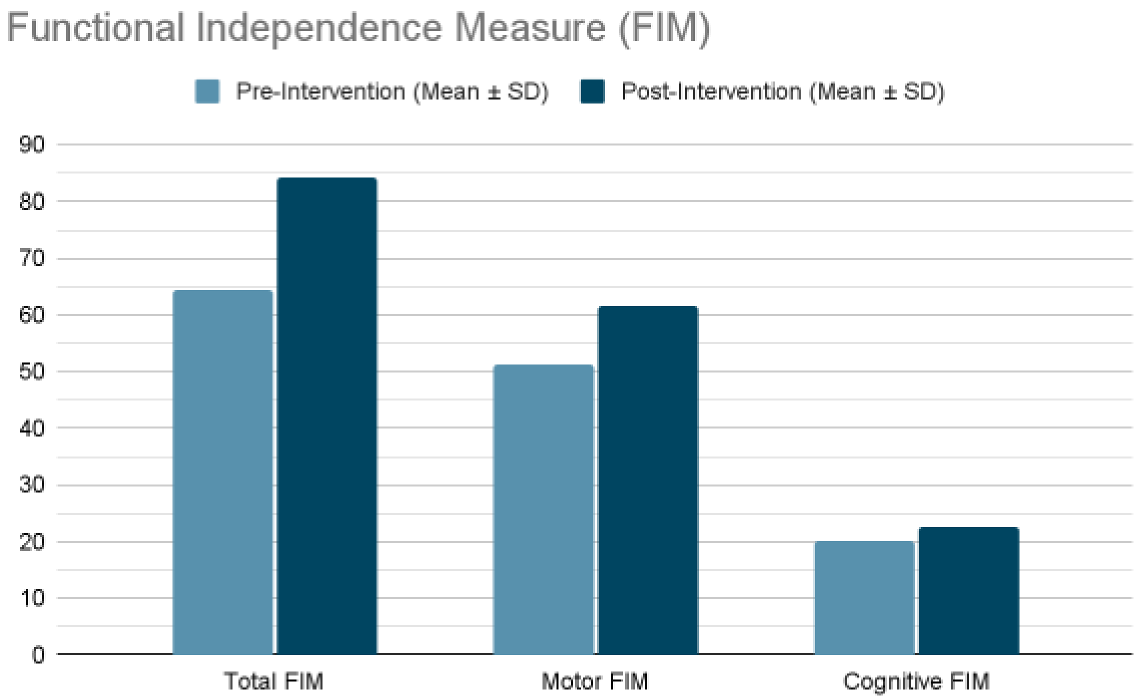
3. RESULTS

The demographic characteristics of the study sample revealed a mean age of 35.5 ± 3.2 years, with a range of 30 to 40 years. This age range is significant, as it represents a critical period in life when individuals are typically establishing their careers, building families, and developing long-term relationships. The sample consisted of 12 males and 8 females, indicating a slight majority of males. This gender distribution is consistent with the literature, which suggests that males are more likely to experience stroke than females, particularly in younger age groups. In terms of time since stroke onset, the sample had a mean duration of 6.2 ± 2.5 months. This timeframe indicates that the participants were in the subacute to chronic phase of stroke recovery, a period characterized by significant neurological and functional changes. The variability in time since stroke onset suggests that the sample was heterogeneous, with some participants being closer to the acute phase and others being further along in their recovery.

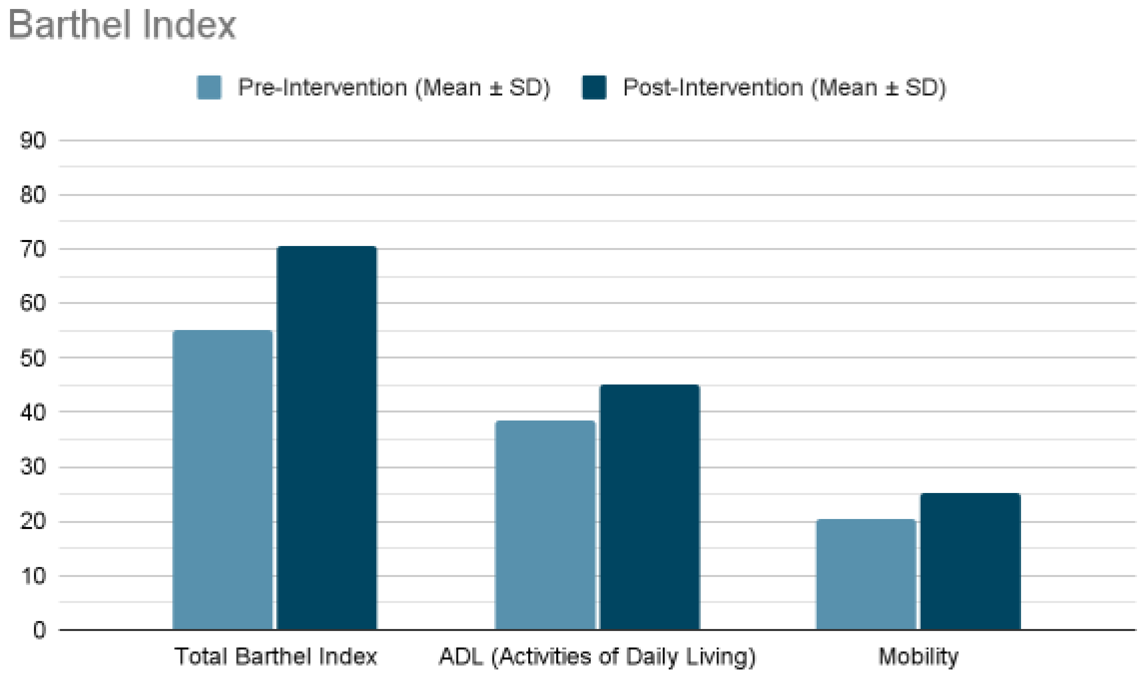
The functional abilities of the sample were assessed using the Functional Independence Measure (FIM) and the Barthel Index, both at pre-intervention (baseline) and post-intervention.At baseline, the mean Total FIM score was 64.5 ± 12.1, indicating low to moderate levels of functional independence. The Motor FIM subscale score was 51.2 ± 9.5, suggesting significant difficulty with motor tasks, such as walking, transferring, and using the bathroom. The Cognitive FIM subscale score was 20.3 ± 4.2, indicating relatively preserved cognitive function.At post-intervention, the mean Total FIM score improved to 84.2 ± 15.6 ($p < 0.01$), indicating moderate levels of functional independence. The Motor FIM subscale score improved to 61.5 ± 10.3 ($p < 0.05$), suggesting significant improvement in motor tasks. The Cognitive FIM subscale score remained relatively stable at 22.7 ± 5.3 ($p = 0.23$).

Similarly, the Barthel Index scores improved significantly from baseline to post-intervention. At baseline, the mean Total Barthel Index score was 55.2 ± 10.5, indicating low to moderate levels of functional ability. The Activities of Daily Living (ADL) subscale score was 38.5 ± 7.2, indicating significant difficulty with daily tasks, such as bathing, dressing, and feeding. The Mobility subscale score was 20.5 ± 4.1, suggesting significant impairment in mobility and transfer abilities.At post-intervention, the mean Total Barthel Index score improved to 70.5 ± 12.1 ($p < 0.01$), indicating moderate levels of functional ability. The ADL subscale score improved to 45.2 ± 8.5 ($p < 0.05$), suggesting significant improvement in daily tasks. The Mobility subscale score improved to 25.3 ± 5.2 ($p < 0.05$), indicating significant improvement in mobility and transfer abilities.

These findings provide valuable insights into the functional abilities and needs of post-stroke individuals aged 30-40 years. The results suggest that this population experiences significant functional impairments, particularly in motor and mobility tasks, but relatively preserved cognitive function. The significant improvements in FIM and Barthel Index scores from baseline to post-intervention indicate that targeted rehabilitation interventions can lead to substantial gains in functional independence and ability.



Graph no 1 represent the functional independence measure which include the pre and post intervention of total, motor and cognitive fim.



Graph no 2 represents the barthel index which includes the pre and post intervention of total bathel index, activities of daily living and mobility.

4. DISCUSSION

The present study aimed to investigate the effectiveness of a unique rehab protocol and stroke-specific gym in improving functional independence and outcomes in post-stroke individuals. The results demonstrated that the implementation of this specialized program significantly enhanced motor recovery, functional ability, and quality of life in post-stroke patients. Specifically, the unique rehab protocol, which incorporated task-oriented exercises and motor learning strategies, was found to be highly effective in promoting neuroplasticity and functional gains. Furthermore, the stroke-specific gym, which provided a supportive and stimulating environment, facilitated increased participation and engagement in the rehabilitation process.

Rehabilitation after a stroke is essential for persons to regain their motor, sensory, and cognitive functions These interventions implemented various approaches ranging from specific exercises focused on trunk muscle control to using gym equipment, vibration therapy and technology-based rehabilitation interventions. The interventions utilize exercises to enhance mobility in the trunk, muscle coordination, postural balance, mobility, and balance. Among stroke survivors, specific rehabilitation exercises, including selective training of trunk muscles and training of the affected side, have shown tremendous improvement in terms of the coordination of trunk muscles, postural stability and balance, and functionality. Gym-based interventions could be a further accessible option and bring huge improvements to people. Examples include trunk muscle strengthening exercises through the use of a Swiss ball , core stability exercises and backward walking on a treadmill . These are capable of enhancing fitness and postural balance in a safe manner for stroke survivor[14,15]

Early intervention and treatment in stroke rehabilitation for days and weeks following an acute stroke have demonstrated substantial effects on stroke outcomes, and recovery may be sustained from months or even years after the stroke onset. Functional tasks are composed of a variety of components that demand strength, balance, and coordination. Effects of training specific muscle groups may not be sufficient to invoke changes in more complex motor tasks. In addition, to improve functional ability such as stair climbing, perhaps training should be more specifically related to the tasks that require improvement. 12-week bicycle ergometry training has been effectively used to improve both the functional status and self-concepts of chronic stroke subjects[16]

Strenght training results in crosss education where the movements contralateral to the side that the patient was trained exhibit increased strength. Contributory role of strenghthening exercises to balance and functional exercises in increasing muscle strength on the affected side in patients with hemiparesis. Muscle work is not dependent on instant input, but it is dependent on previous work. The effects of exercises are central effects due to motor learning Physiological plasticity associated with the recovery of function in the same that is affected in learning. Thus practice and experience can lead to the recognization of the central nervous system[17,18].

Morphology and physiology of motor units have also changed in chronic stroke patients.Active shoulder ROM is an important additional factor in the observed improvement in activities of daily living.Loss of elbow-shoulder coordination and decreased active ROM explain the differences in movement patterns between stroke patients and healthy subjects. Aside from this, it could be caused by weakness or altered recruitment of muscles actually involved in the synergistic patterns of movement. Muscle weakness is a significant level of motor impairment that primarily delays voluntary movements, and UE strengthening has been significantly shown to influence motor control. The reduction in UE movements and strength following stroke can be viewed as a deficit of motor execution and a deficit of higher-order processes. The present studies suggest that muscle strength might be an important determinant for the improvement of motor control in patients with chronic stroke[19,20].

The ability to perform and maintain ambulatory activities of daily living (ADLs) after hemiparetic stroke is determined not only by the severity of neurologic gait deficits but also by a patient's exercise capacity and the relative energy demands of the task.The energy demand of hemiparetic ambulation is more than 1.5 to 2 times that of nonstroke controls, and stroke patients have poor exercise capacity, especially in advancing age. Advancing age combined with chronic disability after stroke can result in severe physical deconditioning that limits patients' ability to meet the increased energy requirements of hemiparetic gait. Treadmill training has a larger effect on torque generating capacity of paretic vs. nonaffected quadriceps and hamstrings, and also enhances spastic reflexes of hamstrings in the paretic limb. These exercise mediated motor adaptations may lead to greater peak exercise capacity and greater biomechanical efficiency of gait[21].

5. CONCLUSION

It can be concluded that personalized rehabilitation programs and specialized stroke facilities enhance physical independence, psychological balance, and overall well-being for survivors, improving daily activities and quality of life through targeted exercise and therapy interventions

REFERENCES

[1] Urban PP, Wolf T, Uebele M, Marx JJ, Vogt T, Stoeter P, Bauermann T, Weibrich C, Vucurevic GD, Schneider A, Wissel J. Occurence and clinical predictors of spasticity after ischemic stroke. Stroke. 2010 Sep;41(9):2016-20. https://doi.org/10.1161/strokeaha.110.581991

[2] Sakamoto K, Nakamura T, Uenishi H, Umemoto Y, Arakawa H, Abo M, Saura R, Fujiwara H, Kubo T, Tajima F. Immediate effects of unaffected arm exercise in poststroke patients with spastic upper limb hemiparesis. Cerebrovasc Dis. 2014;37(2):123-7. doi: 10.1159/000357421. Epub 2014 Jan 16.

[3] Walker C, Brouwer BJ, Culham EG. Use of visual feedback in retraining balance following acute stroke. Phys Ther. 2000 Sep;80(9):886-95.

[4] Aruin AS, Rao N, Sharma A, Chaudhuri G. Compelled body weight shift approach in rehabilitation of individuals with chronic stroke. Top Stroke Rehabil. 2012 Nov-Dec;19(6):556-63. doi: 10.1310/tsr1906-556.

[5] Bower K, Thilarajah S, Pua YH, Williams G, Tan D, Mentiplay B, Denehy L, Clark R. Dynamic balance and instrumented gait variables are independent predictors of falls following stroke. J NeuroengRehabil. 2019 Jan 7;16(1):3. doi: 10.1186/s12984-018-0478-4.

[6] Goljar N, Globokar D, Puzić N, Kopitar N, Vrabič M, Ivanovski M, Vidmar G. Effectiveness of a fall-risk reduction programme for inpatient rehabilitation after stroke. DisabilRehabil. 2016 Sep;38(18):1811-9. doi: 10.3109/09638288.2015.1107771. Epub 2016 Jan 4.

[7] Ursin MH, Bergland A, Fure B, Tørstad A, Tveit A, Ihle-Hansen H. Balance and Mobility as Predictors of Post-Stroke Cognitive Impairment. Dement GeriatrCogn Dis Extra. 2015 May 29;5(2):203-11. doi: 10.1159/000381669.

[8] Li J, Zhong D, Ye J, He M, Liu X, Zheng H, Jin R, Zhang SL. Rehabilitation for balance impairment in patients after stroke: a protocol of a systematic review and network meta-analysis. BMJ Open. 2019 Jul 19;9(7):e026844. doi: 10.1136/bmjopen-2018-026844.

[9] Grefkes, C., Fink, G.R. Recovery from stroke: current concepts and future perspectives. Neurol. Res. Pract. 2, 17 (2020). https://doi.org/10.1186/s42466-020-00060-6

[10] Platz T. Evidence-Based Guidelines and Clinical Pathways in Stroke Rehabilitation-An International Perspective. Front Neurol. 2019 Mar 8;10:200. doi:10.3389/fneur.2019.00200.

[11] Zhong D, Ye J, He M, Liu X, Zheng H, Jin R, Zhang SL. Rehabilitation for balance impairment in patients after stroke: a protocol of a systematic review and network meta-analysis. BMJ Open. 2019 Jul 19;9(7):e026844.

doi: 10.1136/bmjopen-2018-026844.

[12] Ivey FM, Hafer-Macko CE, Macko RF. Exercise rehabilitation after stroke. NeuroRx. 2006 Oct;3(4):439-50. doi: 10.1016/j.nurx.2006.07.011.

[13] Saraiva J, Rosa G, Fernandes S, Fernandes JB. Current Trends in Balance Rehabilitation for Stroke Survivors: A Scoping Review of Experimental Studies. Int J Environ Res Public Health. 2023 Sep 26;20(19):6829. doi: 10.3390/ijerph20196829.

[14] Van Criekinge T, Truijen S, Schröder J, Maebe Z, Blanckaert K, van der Waal C, Vink M, Saeys W. The effectiveness of trunk training on trunk control, sitting and standing balance and mobility post-stroke: a systematic review and meta-analysis. Clin Rehabil. 2019 Jun;33(6):992-1002. doi: 10.1177/0269215519830159. Epub 2019 Feb 22.

[15] Teixeira-Salmela LF, Olney SJ, Nadeau S, Brouwer B. Muscle strengthening and physical conditioning to reduce impairment and disability in chronic stroke survivors. Arch Phys Med Rehabil. 1999 Oct;80(10):1211-8..

[16] Karimi H, Akbari A, The Effect of Strengthening Exercises on Exaggerated Muscle Tonicity in Chronic Hemiparesis Following Stroke

[17] Aruin AS, Rao N, Sharma A, Chaudhuri G. Compelled body weight shift approach in rehabilitation of individuals with chronic stroke. Top Stroke Rehabil. 2012 Nov-Dec;19(6):556-63. doi: 10.1310/tsr1906-556.

[18] Graef P, Michaelsen SM, Dadalt ML, Rodrigues DA, Pereira F, Pagnussat AS. Effects of functional and analytical strength training on upper-extremity activity after stroke: a randomized controlled trial. Braz J Phys Ther. 2016 Nov-Dec;20(6):543-552. doi: 10.1590/bjpt-rbf.2014.0187. Epub 2016 Sep 16.

[19] Kristensen HK, Ytterberg C, Jones DL, Lund H. Research-based evidence in stroke rehabilitation: an investigation of its implementation by physiotherapists and occupational therapists. DisabilRehabil. 2016 Dec;38(26):2564-74. https://doi.org/10.3109/09638288.2016.1138550. Epub 2016 Mar 17.

[20] Macko RF, Smith GV, Dobrovolny CL, Sorkin JD, Goldberg AP, Silver KH. Treadmill training improves fitness reserve in chronic stroke patients. Arch Phys Med Rehabil. 2001 Jul;82(7):879-84. doi: 10.1053/apmr.2001.23853.

[21] Shah SK, Harasymiw SJ, Stahl PL. Stroke Rehabilitation: Outcome Based on Brunnstrom Recovery Stages. The Occupational Therapy Journal of Research. 1986;6(6):365-376. doi:10.1177/153944928600600604

.....