Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 8s, https://carcinogenesis.com/

Effect Of Elastic Dyanamic Sling And Proximal Strength Training On Subluxation In Hemiplegic Shoulder

Dr. Piyusha Jadhav[1], Dr. Suraj Kanase[2]

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

[2]Professor/Head of Department Neuro Physiotherapy Krishna College of Physiotherapy , Krishna Vishwa Vidyapeeth, Karad.

***Corresponding Author:**

Dr Suraj Kanase

Professor / HOD, Department Neuro Physiotherapy , KVV , Karad.

Email ID : drsurajkanase7@gmail.com

ABSTRACT

Background: Stroke is a leading cause of long-term disability, often resulting in hemiplegia and associated complications such as shoulder subluxation. Shoulder subluxation caused by muscle weakness and loss of joint stability, can hinder rehabilitation and functional recovery. Elastic dynamic slings provide dynamic support to maintain shoulder alignment, while proximal shoulder strength training aims to strengthen muscles critical for joint stability.

Objective: To evaluate the effectiveness of elastic dynamic sling combined with proximal (shoulder girdle) strength training in reducing shoulder subluxation in subacute stroke patients.

Methodology : Thirty post-stroke hemiplegic patients with clinically diagnosed shoulder subluxation were enrolled in a single-group intervention study. Outcome measures included shoulder subluxation grading, the Fugl-Meyer Assessment (FMA) for upper limb motor control, and the Stroke Rehabilitation Assessment of Movement (STREAM) for motor recovery. Assessments were conducted at baseline (Week 1), mid-intervention (Week 3), and post-intervention (Week 6).

Results : This showed a significant reduction in shoulder subluxation severity, with mean grading scores decreasing from 2.6 at baseline to 1.3 by Week 6 ($p = 0.0001$). Motor function also improved significantly, as reflected by an increase in Fugl-Meyer Assessment scores from 37.8 to 48.2 ($p = 0.0031$), and STREAM scores from 30.1 to 48.4 ($p = 0.0132$). Radiographic assessment of shoulder subluxation was conducted by measuring the vertical distance between the inferior glenoid rim and the humeral head significantly reduced to 5.1 ± 1.2 mm at Week 6 ($p =$

0.0001).These findings suggest that the combined therapy effectively enhances shoulder stability, motor control, and functional mobility in stroke rehabilitation.

Conclusion : The combined use of elastic dynamic sling and proximal strength training is a promising approach to reduce shoulder subluxation and enhance upper limb motor function in hemiplegic stroke patients, supporting improved rehabilitation outcomes..

Keywords: *Stroke, Hemiplegia, Shoulder Subluxation, Elastic Dynamic Sling, Proximal Strength Training, Fugl-Meyer Assessment, STREAM.*

How to Cite: Dr. Piyusha Jadhav, Dr. Suraj Kanase, (2025) Effect Of Elastic Dyanamic Sling And Proximal Strength Training On Subluxation In Hemiplegic Shoulder, *Journal of Carcinogenesis*, *Vol.24, No.8s*, 851-859

1. INTRODUCTION

Stroke has become a major public health issue globally, with high-income countries (HICs) showing progress in reducing stroke-related mortality and disability through improved prevention, diagnosis, and care[1,2]. However, low- and middle-income countries (LMICs), including India, face a growing burden, accounting for approximately 70% of global stroke incidence, and over 87% of stroke-related deaths and disability-adjusted life years (DALYs). The disparity is compounded by limited healthcare access, delayed presentations, and inadequate rehabilitation services[3,4].

India, experiencing a demographic transition with increased life expectancy, is seeing a rise in non-communicable diseases (NCDs), including stroke. Stroke is now the fourth leading cause of death and the fifth leading cause of disability in India, with this trend expected to worsen due to aging populations, urbanization, and the rising prevalence of hypertension and diabetes. In 2016, the Global Burden of Disease (GBD) study estimated 1.17 million new stroke cases in India, though significant methodological variations in studies make these estimates imprecise[5,6].

Accurate, high-quality data on stroke epidemiology is critical to shaping health policy, optimizing resources, and developing effective, context-specific stroke care strategies.

Following a cerebrovascular accident (stroke), particularly in individuals who develop hemiplegia, there is a significant loss of voluntary motor control in the affected upper limb. During the acute and subacute stages, patients commonly experience flaccidity, where the muscle tone is greatly diminished. This condition leads to an immediate loss of function in the dynamic stabilizers of the shoulder. Without the active contraction of these muscles to hold the humeral head in place, the static stabilizers are subjected to excessive strain. The weight of the unsupported arm, combined with the force of gravity, causes the humeral head to shift downward (inferior subluxation) and sometimes forward (anterior subluxation) from the glenoid cavity. Over time, this gravitational pull stretches the joint capsule, tendons, and ligaments, weakening their structural integrity and resulting in mechanical misalignment of the shoulder joint.

Inappropriate patient handling can further contribute to this problem. For example, pulling on the hemiplegic arm during transfers, allowing the arm to dangle unsupported while sitting or lying down, or failure to provide adequate support in bed or in a wheelchair can exacerbate the subluxation. Improper positioning of the scapula due to weakened scapular stabilizers also affects the alignment of the glenohumeral joint. All these factors collectively increase the likelihood of developing shoulder subluxation in post-stroke patients[7].

Post-stroke rehabilitation aims to restore motor function, with many stroke survivors experiencing varying degrees of motor dysfunction, particularly in the upper limbs, significantly affecting their ability to perform daily tasks and leading to a loss of independence[8] Strengthening these muscles through active movement is key to reducing shoulder subluxation. By focusing on muscle activation around the shoulder, especially in the early stages of recovery, patients are more likely to improve joint stability, reduce pain, and regain better arm function.[9,10]

Elastic dynamic slings are assistive devices used in stroke rehabilitation to support the affected limb during movement. These devices incorporate elastic components that provide controlled resistance, allowing for a range of motion while promoting proper alignment and reducing spasticity, a common post-stroke issue. Their primary function is to alleviate strain on weakened muscles, facilitating therapeutic exercises with greater ease and comfort[11,12].

These slings play a key role in neuromuscular re-education by encouraging controlled limb movement, which activates brain motor pathways and supports neuroplasticity helping the brain reorganize itself after a stroke. This process is crucial for restoring motor control and improving overall limb function. Additionally, elastic dynamic slings may help to prevent contractures (permanent muscle shortening) and joint deformities, common complications in post-stroke recovery. These slings can improve muscle strength, flexibility, and coordination through active-assisted exercises, while reducing spasticity by providing gentle resistance. This leads to smoother, more controlled movements during rehabilitation. Beyond physical recovery, the use of elastic dynamic slings enhances functional outcomes, allowing patients to regain independence in daily tasks like dressing and eating. They may improve the quality of life for stroke survivors, reducing caregiving needs and boosting psychological well-being by promoting self-sufficiency and autonomy[13,14].

2. MATERIAL AND METHODOLOGY

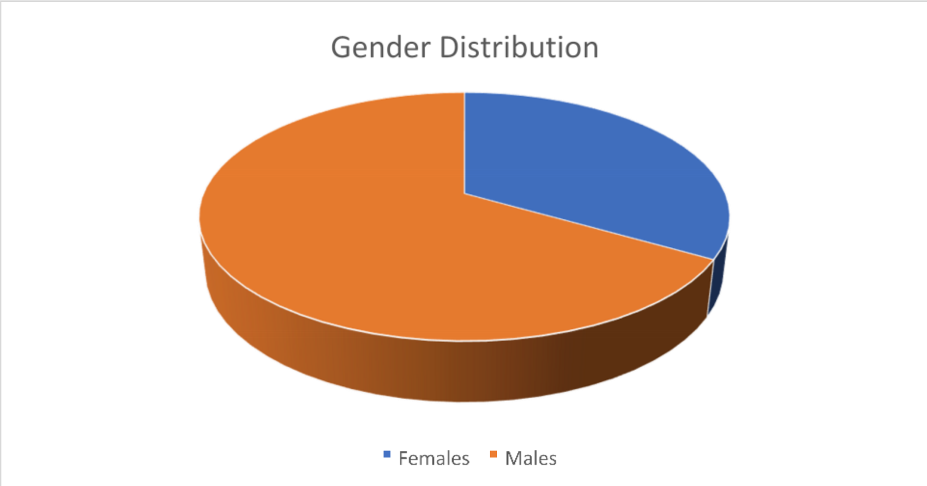
This study was conducted with 30 subjects, all diagnosed with subacute stroke, defined by an onset period ranging from 2 weeks to 6 months. The subjects were aged between 40 and 75 years and presented with hemiplegia along with clinically confirmed shoulder subluxation, either confirmed through palpable gap or radiologically. Only those who were medically stable and able to participate in a rehabilitation program were included in the study. Each participant provided voluntary consent to be part of the research.

The inclusion criteria focused on individuals diagnosed with subacute stroke, exhibiting specific symptoms of hemiplegia and shoulder subluxation, which were confirmed either clinically or through imaging. In order to ensure consistency and avoid confounding variables, certain exclusion criteria were applied. Individuals with a history of pre-existing shoulder pathology, including rotator cuff tears, dislocations, or fractures, were excluded, as were patients exhibiting severe spasticity in the upper limb, as measured by a Modified Ashworth Scale score of greater than 2. Those with severe sensory deficits or neglect that would impair upper limb awareness were also excluded from the study. Furthermore, individuals with underlying cardiopulmonary conditions or other systemic illnesses that would limit their ability to participate in the rehabilitation process were not included. Patients with a history of recurrent stroke or bilateral involvement were also excluded from participation to ensure homogeneity in the sample population and minimize the effects of additional neurological impairments.

3. RESULT:-

Gender distribution in the study

Graph 1: Gender Distribution



Graph no.1 Gender wise Distribution

Interpretation: In the above table and graph shows that 75% are males and 25% are females of total population participated in the study.

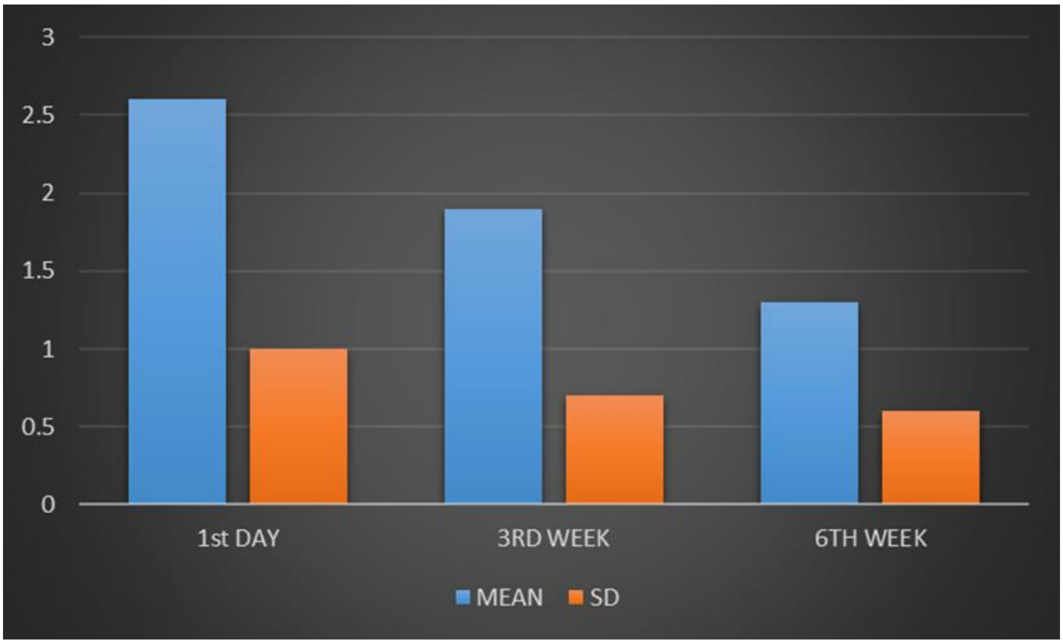
Outcome Measures

Within the group:-

SHOULDER SUBLUXATION GRADING

	MEAN ± SD	P VALUE	F VALUE
1st DAY	2.6 ± 1.0	0.07	34.780
3RD WEEK	1.9 ± 0.7	0.01	
6TH WEEK	1.3 ± 0.6	0.0001	

TABLE NO. 1 1st day,2nd Week,6th Week Mean score of shoulder subluxation grading



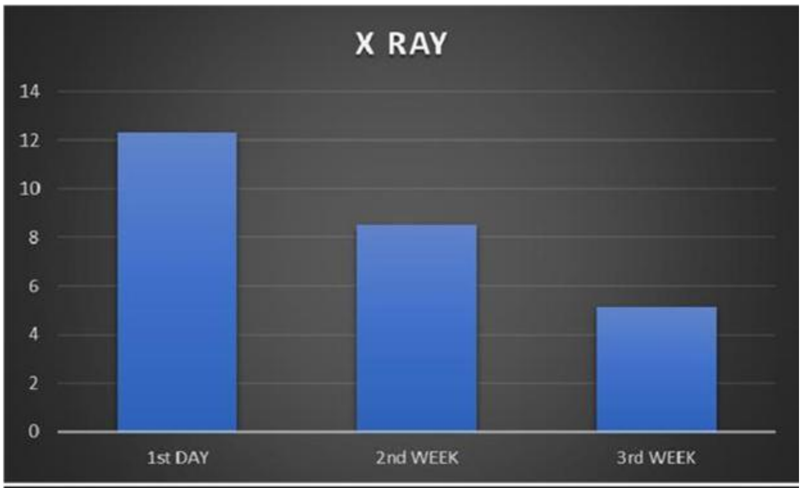
Graph no 1ST day ,3RD week, 6THweek mean score for Shoulder subluxation grading

Interpretation: In the above table and graph shows that 1st day ,3rd week, 6th week values of shoulder subluxation grading is 2.6 ± 1.0 and 1.9 ± 0.7 post value 1.3 ± 0.6 with p value 0.0001

X-RAY :

Table No.2 Pre and Post of X-RAY value

	MEAN ± SD	**P value**	**F VALUE**
1st DAY	12.3 ± 1.7	0.169	71.28
3RD WEEK	8.5 ± 1.4	0.0039	
6TH WEEK	5.1 ± 1.2	0.0001	



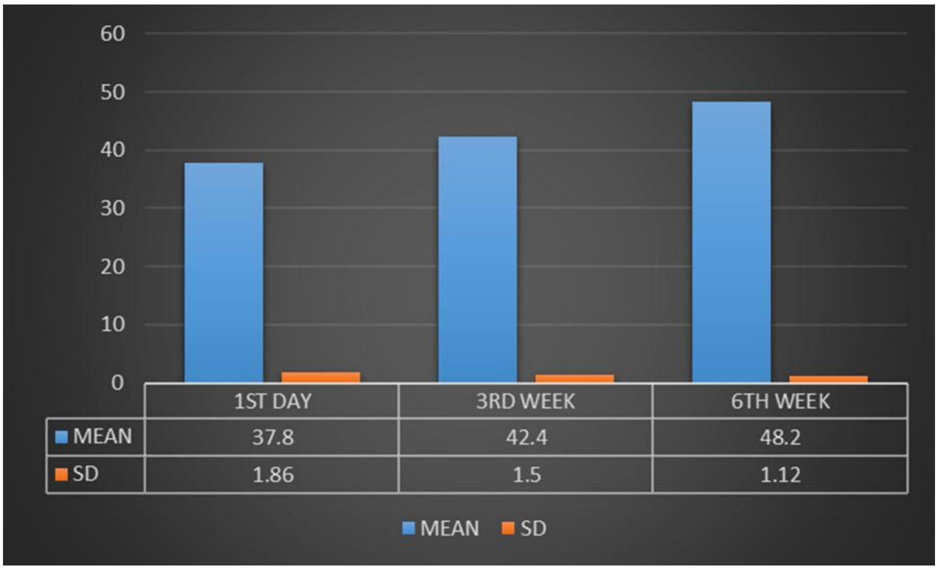
Graph no. 3: X-ray

Interpretation :- At Week 1, the average vertical displacement was 12.3 mm, indicating moderate shoulder subluxation. By Week 3, it reduced to 8.5 mm, showing significant improvement in joint alignment.At Week 6, the mean distance was further reduced to 5.1 mm, nearing the normal alignment range (≤5 mm).The decrease in vertical subluxation over time was statistically significant, with $p < 0.05$ at both Week 3 and Week 6. This suggests that the combined use of the elastic dynamic sling and proximal strength training was effective in reducing shoulder subluxation over the 6-week intervention period.

FUGL MEYER ASSESSMENT

	MEAN ± SD	**P VALUE**	**F VALUE**
1ST DAY	37.8 ± 1.86	0.07	208.93
3RD WEEK	42.4 ± 1.50	0.01	
6TH WEEK	48.2 ± 1.12	0.0031	

TABLE NO.3 1ST day,2nd Week,6th Week Mean score of Fugl Meyer Assessment



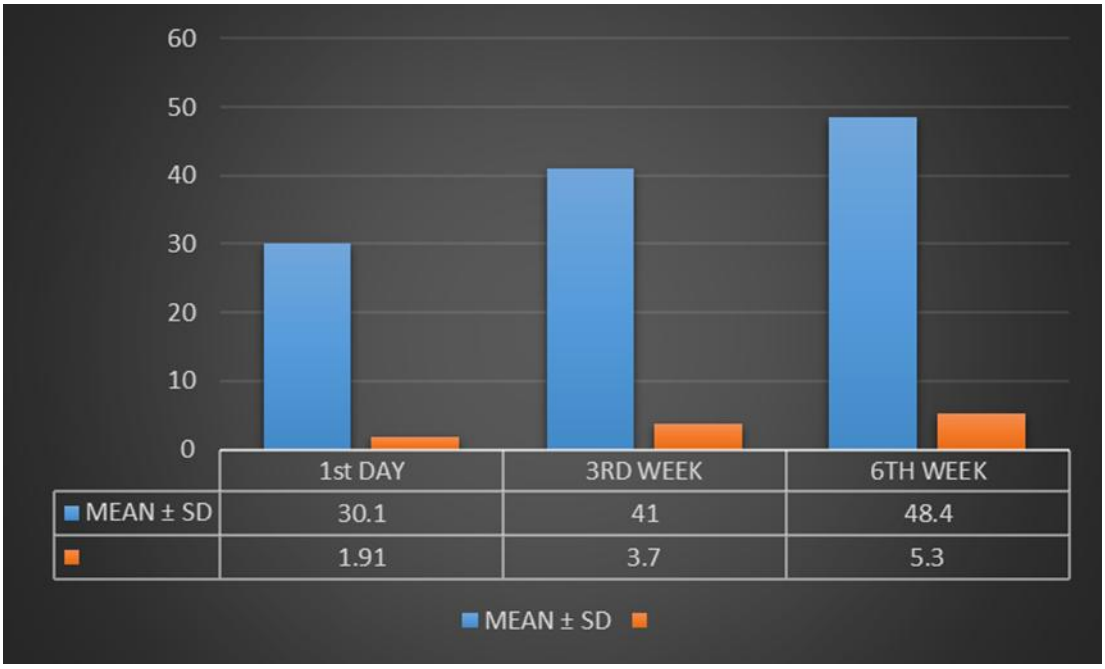
Graph no 1STday ,3RDweek, 6THweek mean score for Fugl Meyer Assessment

Interpretation: In the above table and graph shows that 1st day ,3rd week, 6th week values of Fugl Meyer Assessment is 37.8 ± 1.86 and 42.4 ± 1.50 post value 48.2 ± 1.12 with p value 0.0031

STREAM :

	MEAN ± SD	P value	F VALUE
1st DAY	30.1 ± 1.91	0.10	247.65
3RD WEEK	41 ± 5.3	0.05	
6TH WEEK	48.4 ± 3.7	0.0132	

TABLE NO. 4 1ST day,2Nd Week,6th Week Mean score of STREAM



Graph no 1ST day ,3RD week, 6TH week mean score for STREAM

Interpretation: In the above table and graph shows that 1st day ,3rd week, 6th week values of STREAM is 30.1 ± 1.91 And 41 ± 5.3 post value 48.4 ± 3.7 with p value 0.0132

OUTCOME MEASURE P VALUES :-

MEASURES	DAY 1 (MEAN± SD)	WEEK 3 (MEAN ± SD	WEEK 6 (POST VALUES)	P VALUE
SHOULDER SUBLUXATION GRADING	2.6 ± 1.0	1.9 ± 0.7	1.3 ± 0.6	**0.0001**

FUGL MEYER ASSESSMENT (MOTOR)	37.8 ± 1.86	42.4 ± 1.50	48.2 ± 1.12	**0.0031**
STREAM	30.1 ± 1.91	41 ± 5.3	48.4 ± 3.7	**0.00132**
X-RAY	12.3 ± 1.7	5.1 ± 1.2	5.1 ± 1.2	**0.0001**

The analysis of shoulder subluxation grading revealed a significant decrease from a mean score of 2.6 on Day 1 to 1.3 by Week 6 ($p = 0.0001$, $F = 34.780$), indicating a substantial reduction in the severity of shoulder subluxation over the course of the intervention. This significant improvement suggests that the combined therapy, likely involving both mechanical support from the sling and targeted strengthening exercises, effectively contributed to stabilizing the shoulder joint and preventing further displacement.

Similarly, motor function as measured by the Fugl-Meyer Assessment showed a significant increase from 37.8 at baseline to 48.2 by Week 6 ($p = 0.0031$, $F = 208.93$). This large F value highlights a robust effect of the intervention on upper limb motor recovery, suggesting that the therapeutic exercises successfully enhanced neuromuscular control and coordination in the affected limb.

Moreover, the STREAM (Stroke Rehabilitation Assessment of Movement) scores improved significantly, rising from 30.1 to 48.4 by Week 6 ($p = 0.0132$, $F = 247.65$). This substantial increase reflects meaningful gains in overall motor recovery and functional mobility, demonstrating that the combined intervention not only improved isolated motor functions but also translated to better integrated and functional movements necessary for daily activities. Radiographic assessment of shoulder subluxation was conducted by measuring the vertical distance between the inferior glenoid rim and the humeral head. At baseline (Week 1), the mean vertical distance was 12.3 ± 1.7 mm, indicating moderate subluxation. By Week 3, this was significantly reduced to 8.5 ± 1.4 mm ($p = 0.0039$), and further decreased to 5.1 ± 1.2 mm at Week 6 ($p = 0.0001$). These results demonstrate a statistically significant improvement in shoulder alignment over the 6-week intervention period.

Together, these findings indicate that the combined therapy protocol was highly effective in reducing shoulder subluxation severity while simultaneously promoting significant motor recovery and functional improvement in patients over a six-week period.

4. DISSCUSION

The study highlights the beneficial effects of combining elastic dynamic sling support with proximal strength training in reducing shoulder subluxation in individuals with hemiplegia following a stroke. Shoulder subluxation, commonly observed during the subacute phase of stroke recovery, occurs due to flaccidity and weakness of the shoulder stabilizing muscles, leading to displacement of the humeral head from the glenoid fossa. Individually, both elastic slings and muscle-strengthening techniques have been shown to provide positive effects; however, this study focused on evaluating their synergistic impact when applied together.

The elastic dynamic sling supports the arm by counteracting gravitational pull and assisting in maintaining proper joint alignment. It reduces mechanical stress on passive structures like the joint capsule and ligaments. At the same time, proximal strength training targets the activation and strengthening of the deltoid, rotator cuff, and scapular stabilizing muscles key dynamic stabilizers of the shoulder joint. Over time, this promotes neuromuscular re-education, improves joint congruency, and restores muscular balance, contributing to functional stability of the shoulder complex.

Findings from the intervention showed a notable reduction in both horizontal and vertical subluxation distances, as measured by clinical grading scales and imaging. Additionally, patients demonstrated improved scores in upper limb motor function assessments such as the Fugl-Meyer Assessment and the STREAM (Stroke Rehabilitation Assessment of Movement), suggesting enhanced movement control and arm use in daily activities.

In summary, this study provides strong evidence that a combined therapeutic approach using both elastic dynamic sling support and proximal strength training yields greater improvements in subluxation reduction and functional recovery than when each method is used alone. It supports integrating both techniques into early rehabilitation programs to optimize outcomes in stroke survivors with hemiplegic shoulder subluxation.

In this study, researchers evaluated the effects of two types of shoulder strapping longitudinal and circumferential on managing shoulder subluxation and pain in stroke patients. The results showed that longitudinal strapping was more effective, leading to a reduction in both shoulder pain and subluxation. It provided upward support, which helped maintain proper alignment of the shoulder joint and prevented worsening symptoms. our results confirm that external mechanical support is a critical component in managing hemiplegic shoulder subluxation. The elastic dynamic sling offers a unique advantage by combining the structural support of strapping with the active engagement of therapeutic exercise. While proximal strength training remains important, especially in the later stages of recovery, the sling appears to be more effective in the early phase, offering both immediate alignment and a platform for motor relearning. These findings support the integration of dynamic support systems into early stroke rehabilitation protocols to optimize outcomes and reduce complications associated with shoulder subluxation.[15]

This study found that using the elastic dynamic sling for a longer period (8 weeks) significantly reduced horizontal shoulder subluxation more than after just 4 weeks, showing its increased effectiveness over time. In comparison, the Bobath sling, used by the control group, mainly provided proximal support and helped maintain overall upper limb alignment. It positioned the arm in abduction and extension, which may help reduce flexor spasticity, but it was less effective in directly correcting shoulder subluxation These findings suggest that an integrated approach may be ideal. While dynamic sling training provides immediate biomechanical alignment and neuromuscular re-education, proximal strength training can complement this by building the muscular foundation needed for long-term shoulder stability. Future research should explore the combined effects of these interventions to determine whether their synergy leads to superior outcomes in managing hemiplegic shoulder subluxation. In conclusion, this study supports the growing body of evidence favoring elastic dynamic sling training as a more effective intervention than static support slings or isolated strengthening exercises, especially when sustained over a longer duration. The dynamic sling's ability to facilitate alignment, reduce subluxation, and support functional use of the upper limb makes it a valuable tool in stroke rehabilitation.[14]

the study involving active shoulder exercises using a sling suspension system, a common theme is evident: supportive, task-specific interventions targeting shoulder stability can significantly aid in the rehabilitation of hemiplegic shoulders. That study reported superior improvements in reducing shoulder subluxation, proprioception, and upper limb motor recovery (as measured by the Fugl-Meyer Assessment) in patients using the sling system compared to those undergoing conventional bilateral arm training. Similarly, our findings indicate that elastic dynamic sling training, which provides dynamic support and facilitates active engagement of stabilizing shoulder muscles, yielded greater improvement in reducing subluxation than proximal strength training alone. This suggests that a neuromechanical approach that combines support and active muscle engagement (such as that offered by both sling-based systems) may be more effective in addressing the multifactorial nature of hemiplegic shoulder subluxation than strengthening exercises that isolate proximal musculature.[8]

Fil et al. studied 48 acute stroke patients with shoulder subluxation under 9.5 mm. They performed targeted strengthening exercises for the rotator cuff and deltoid muscles, focusing on proper shoulder alignment. The study found a reduction in subluxation in the exercise group. These findings support the current study, which also aimed to reduce subluxation in acute stroke patients by using gravity-assisted techniques to encourage controlled shoulder movement. The similarity between our findings and those of Fil et al. also highlights the importance of early intervention. Subluxation in the acute phase is typically more reversible, and interventions that restore joint alignment early may prevent the development of secondary complications such as shoulder pain, soft tissue contractures, or learned non-use. Our results further suggest that combining gravity-assisted support with active engagement (as in the elastic dynamic sling) may provide a more comprehensive approach to rehabilitation than isolated strengthening alone.[16]

Paci et al. identified a direct and clinically relevant correlation between the presence of shoulder joint subluxation and the functional performance of the upper extremity. Their findings suggest that the degree of joint instability directly influences motor control and the overall ability to perform daily tasks involving the affected limb. This underscores the importance of early identification and intervention in patients exhibiting signs of subluxation to mitigate secondary complications and promote functional recovery. In light of these findings, our study reinforces the idea that mechanical joint stabilization and functional activation should be addressed simultaneously. The elastic dynamic sling offers this dual benefit, potentially making it superior to interventions that focus solely on muscle strength. However, proximal strength training still holds value and may serve as a complementary strategy, particularly in the later stages of rehabilitation when patients are better able to engage voluntarily with resistance-based activities.[17]

Similarly, Jonsson et al. conducted a focused clinical study involving ten patients diagnosed with shoulder joint instability as a result of shoulder impingement syndrome. The patients participated in a structured 12-week sling therapy exercise program designed to stabilize the shoulder joint and enhance muscular coordination. Post-intervention assessments revealed a statistically significant improvement in shoulder function scores, indicating the efficacy of targeted rehabilitation protocols in restoring joint stability and improving patient outcomes. These findings support the therapeutic value of sling-based interventions in managing shoulder instability, particularly in cases complicated by impingement pathology.[18]

REFERENCES

[1] Feigin VL, Forouzanfar MH, Krishnamurthi R, et al. Global and regional burden of stroke during 1990–2010: findings from the Global Burden of Disease Study 2010.Lancet 2014; 383: 245–255.

[2] . Global Burden of Disease 2017. Causes of death collaborators. Global, regional, and national age-sex-

specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the Global Burden of Disease Study 2017.

[3] . Horton R andDasP. Indian health: the path from crisis to progress. Lancet 2011; 15: 181–183.

[4] . Sulaja S. Old age mortality in India? An exploration from life expectancy at age 60. Int J Asian Social Sci 2016; 6:698–704.

[5] . Dalal P, Bhattacharjee M, Vairale J and Bhat P. UN millennium development goals: can we halt the stroke epidemic in India? Ann Ind Acad Neurol 2007; 10: 130.

[6] . Naik KR. Challenges in delivering stroke care in India. Ind J Health Sci Biomed Res (KLEU) 2016; 9: 245–246.

[7] .Haacke C, Althaus A, Spottke A, Siebert U, Back T, Dodel R. Long-term outcome after stroke: evaluating health-related quality of life using utility measurements. Stroke. 2006 Jan;37(1):193-8.STR.0000196990.69412.fb. Epub 2005 Dec 8.

[8] .Jung KM, Choi JD. The Effects of Active Shoulder Exercise with a Sling Suspension System on Shoulder Subluxation, Proprioception, and Upper Extremity Function in Patients with Acute Stroke. Med Sci Monit. 2019 Jun 30;25:4849-4855.

[9] .Harpreet K, Singh SS, Jeyaraj D, Kaur SP. Prevalence of post stroke shoulder subluxation and pain. Indian Journal of Physiotherapy and Occupational Therapy. 2014;8(1):5.

[10] 10.Sohn MK, Jee SJ, Hwang P, Jeon Y, Lee H. The effects of shoulder slings on balance in patients with hemiplegic stroke. Annals of rehabilitation medicine. 2015 Dec 29;39(6):986-94.

[11] .Adams, R. D., & Victor, M. (2009). Principles of Neurology (9th ed.). McGraw-Hill. ISBN: 978-0-07-147794-3.

[12] .Carmichael, S. T. (2005). Stroke: Mechanisms of Injury and Impairment. In Handbook of Clinical Neurology (Vol. 81, pp. 285-306). Elsevier.

[13] .Swinnen, S. P., & Wenderoth, N. (2013). Two hands, one brain: Cognitive neuroscience of bimanual skill. Trends in Cognitive Sciences, 17(9), 488-496.

[14] .Kim MG, Lee SA, Park EJ, et al. Elastic Dynamic Sling on Subluxation of Hemiplegic Shoulder in Patients with Subacute Stroke: A Multicenter Randomized Controlled Trial. Int J Environ Res Public Health. 2022 Aug 12;19(16):9975.

[15] .Comley-White N, Mudzi W, Musenge E. Effects of shoulder strapping in patients with stroke: A randomised control trial. S Afr J Physiother. 2018 Aug 29;74(1):430. doi: 10.4102/sajp.v74i1.430.

[16] .Fil A, Armutlu K, Atay AO et al: The effect of electrical stimulation in combination with Bobath techniques in the prevention of shoulder subluxation in acute stroke patients. Clin Rehabil, 2011; 25: 51–59

[17] .Paci M, Nannetti L, Taiti P et al: Shoulder subluxation after stroke: Relationships with pain and motor recovery. Physiother Res Int, 2007; 12: 95–104

[18] .Jonsson P, Wahlström P, Ohberg L et al: Eccentric training in chronic painful impingement syndrome of the shoulder: Results of a pilot study. Knee Surg Sports Traumatol Arthrosc, 2006; 14: 76–81.