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The Effectiveness Of Neurodynamic Techniques On Spasticity In Patients With Stroke - A Systematic Review

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Abstract

Introduction: Stroke is the commonest and most severe neurological disorder, causing reduced functional level, decreased quality of life and even loss of life. Researches with inconsistent outcomes and several procedural restrictions have been directed to evaluate the effectiveness of neurodynamic interventions for patients with stroke.
Objective: This systematic review aimed to investigate the effectiveness of different neurodynamic interventions on patients with stroke.
Method: Five databases (PubMed, Cinhal, Cochrane, Web of Science, Google scholar) were searched to identify eligible studies. Pooled standardized mean differences were calculated using a random effects model. The PRISMA statement was followed to increase clarity of reporting.
Results: Five studies, including 136 patients, reporting on the subject of neurodynamic intervention and conventional physiotherapy were analyzed. These interventions showed a statistically significant effect on gain of range of motion, reduction of spasticity, improvement of myoelectric activity, increase of muscle flexibility and improvement in distribution of body weight and postural balance.
Conclusion: Neurodynamic intervention seemed to be the most effective treatment to reduced spasticity. When it is appropriately targeted, it significantly improves flexibility and postural balance.

Key word: Stroke, Spasticity, Exercise, Neurodynamic

Introduction:

In industrialized countries, stroke is the most frequent cause of disability among adults. The death rate following stroke is set to decrease as a result of better care provision as soon as the problem occurs. It can therefore be expected that the number of people surviving with a disability following a stroke is liable to increase[1]. In addition, the incidence of stroke has increased dramatically among younger subjects, with over 20% of people affected being under the age of 65[2].

According to the American Stroke Association, about 87% of the cases are ischemic, and the remaining 13% are hemorrhagic[3]. The most common symptoms include paralysis (in one or both sides), loss of balance, and spasticity, which commonly appear days or weeks after the occurrence of a stroke[4].

Several manual therapy techniques were used in the management of patients with stroke including neurodynamic or neural mobilization (NM) techniques. Neurodynamic techniques are defined as manual techniques or exercise interventions aimed at affecting the neural structures or surrounding tissue (interface) directly or indirectly with the purpose of reducing pain, decreasing neural tension, and improving muscle flexibility and range of motion[5,6]. Studies revealed that NM improves the elasticity of nervous and musculoskeletal tissues, increases the intraneural blood flow, improves intraneural fluid dispersion, reduces intraneural edema, reduces thermal and mechanical hyperalgesia, and reverses the increased immune responses following a nerve injury[4,5,6]. Neurodynamics restore the mechanical and neurophysiological function of the nerve and can be performed in different ways using active or passive movement, manual mobilization of the nerve or interface, and exercise[7,8]. A study conducted to examine the effect of rhythmic upper extremity neurodynamic for 18 patients with hemiplegia caused by stroke found that rhythmic neurodynamic was effective for improving the functions of upper extremities[9]. A blinded randomized clinical trial study on effectiveness of NMs performed in 12 volunteers, aged between 20 and 80 years, with a diagnosis of ischemic or hemorrhagic stroke showed positive effects in relation to flexibility, lower limb muscle strength, gait, and balance[5]. A study on 26 patients with stroke undertaken to compare the efficacy of instrument-assisted soft tissue mobilization and a neural dynamic technique on lower extremity muscle tone, stiffness, and static balance showed a significant improvement in the instrument-assisted soft tissue mobilization group in muscle tone and stiffness but no difference in static balance[6]. A case report study on a combination therapy of botulinum toxin type A and NM for a patient with severe upper limb spasticity and pain after stroke showed an improved joint range of motion and decreased pain, anxiety, and depression[8]. The aim of this systematic review is to

systematically assess the types and techniques of different neurodynamic interventions used and their effectiveness on pain, disability, functional status, quality of life, and other variables on patients with stroke.

Methods:

Literature Search:

The literature search was restricted to English language publications from 2014 through 2022. Five databases (PubMed, Cinhal, Cochrane, Web of Science, Google scholar) were searched to identify eligible studies. Pooled standardized mean differences were calculated using a random effects model. The PRISMA statement was followed to increase clarity of reporting. The following search terms were used to identify appropriate articles stroke, cerebrovascular disease, hemiplegia, neural, nerve, mobilization, manipulation, physical therapy, physiotherapy, manual therapy, glide, slide, tension, stretching, neurodynamic, and RCTs. A review of references listed in the articles was also performed, for additional articles that met our criteria. During searching process of all related articles, the titles and abstracts were selected according to inclusion-exclusion criteria to recognize actually suitable article. Full manuscripts of selected articles were evaluated individually by two critics.

Study Criteria:

Study design: The review included randomized controlled trial (RCT) as they provide high quality or evidence base and published in English language**.**

Inclusions criteria

This systematic review will consider studies that include human participants older than 18 years affected by stroke.

Intervention

This review considers studies that evaluate neurodynamic interventions performed on patients with stroke. The intervention group (neurodynamic interventions) will be compared to a control group where another or no type of intervention has been performed. NMs are divided into "sliders" and "tensioners." Sliders will elongate the nerve bed through movement at one joint while moving another joint to relieve tension in the nerve. With tensioners, joints are moved in such a way that the nerve bed is elongated and the tension in the nerves increases.

Quality assessment:

Quality of methodology of carefully chosen manuscripts was evaluated by PEDro Scale, containing of 11 questions in two phases. Questions from 2–9 evaluates internal validity while questions from 10–11 evaluates statistical evidences necessary to make a research readable. Each question is scored according to its presence or absence in the evaluated manuscript. The final score is completed by adding all positive responses.

Moseley et al. stated that studies having score more than or equal to 5 out of ten were measured as high quality research. Thus, in this research all included articles scored more than or equal to 5, were found to have high quality in methodology. The articles were evaluated in PEDro scale by two reviewers' independently[10].

Data analysis:

The selected articles were screened by two reviewers independently. They were evaluated in a structured way, consisting of given parameters: author, year, study-design, subject's age, interventions, study-duration, outcome measures, and results. Dissimilarities between the reviewers were resolved by discussions to reach settlement and established via Cohen's kappa statistics.

Outcome Measures

The main outcome measures are Modified Ashworth Scale (MAS), Fugl Meyer Upper Extremity Scale (FMUE), goniometry, Action Research Arm Test, Balancia software, Mintosys Korea, Goniometer, foot pressure test was used to measure the pressure distribution of the soles of the feet and disturbance in a standing position, two-dimensional imaging, Standardized Passive straight leg raise (SLR) test.

RESULTS:

Studies identified:

After applying the inclusion criteria, 50 studies were selected, 25 studies were disqualified as they were found in more than one databank. For eligibility criteria 25 studies were selected. Additionally, 20 articles were omitted due to unavailability of full manuscript and objective, unable to meet inclusion (Figure-1). 05 articles were selected finally, after passing quality evaluation phase.

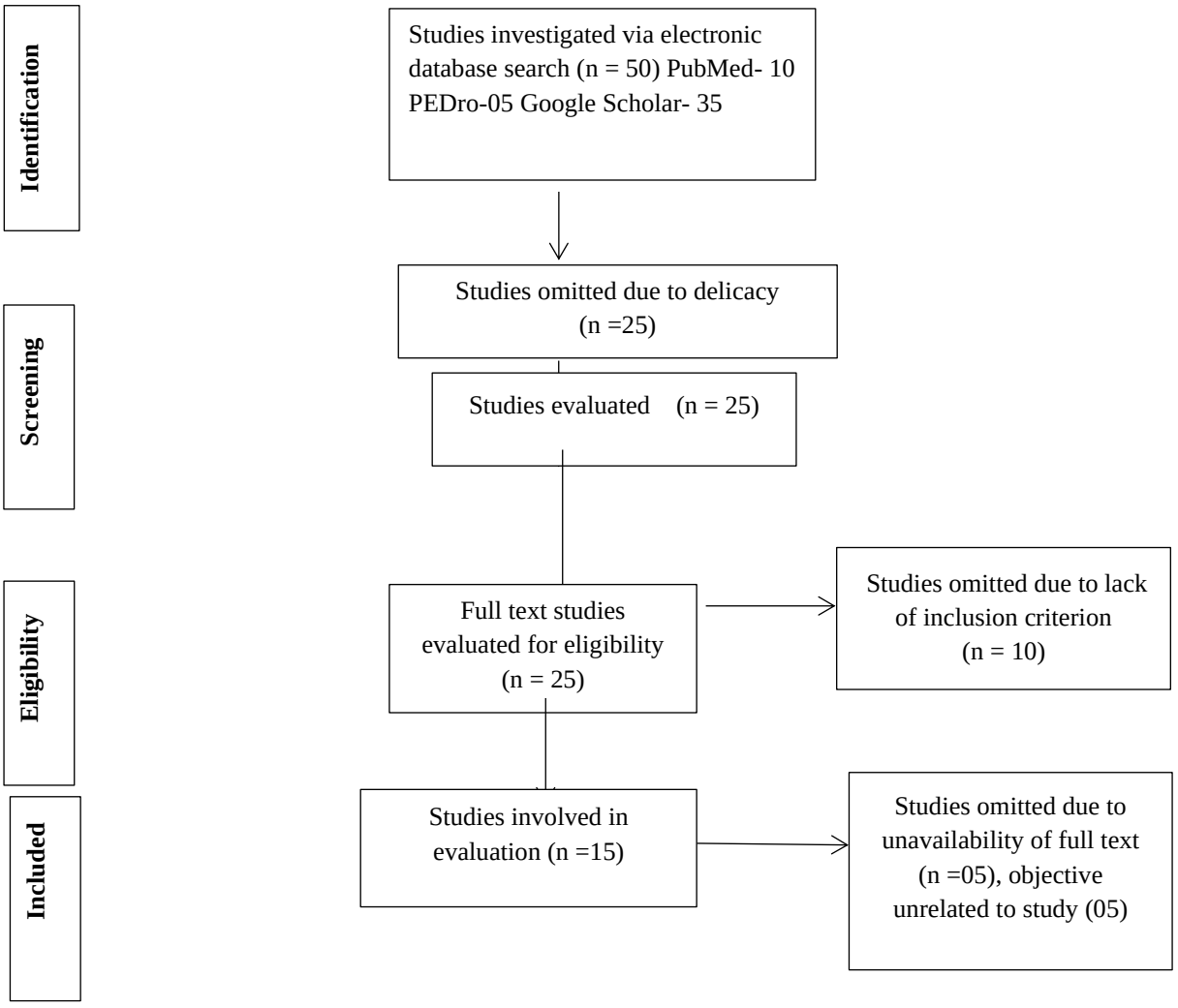

Figure 1: Flow chart displaying the selection of studies

General data of the included studies:

Selected articles in this review are summarized in **Table 1** including given parameters: author-year, study design, subjects, interventions, study duration, outcome measures, and results. Out of the 5 studies included, three were RCTs[11,4,13], one was experimental design[14] and one was Quasi experimental design[12] study. All studies were conducted between 2014 and 2022. Number of participants in the studies ranged from 20 to 46. All articles were experimental. Concerning the efficacy of results established in the most of the articles, neurodynamic techniques were found to be significantly effective on spasticity between pre- and post-intervention assessments.

Table 1- Description of the included studies						
Author	study design	Subject	Intervention	Study Duration	Outcome measure	Result
N Zamurd, M Obaid Baig et. al 2022[11]	Randomized controlled trial	N=46	Group 1: conventional therapy with neurodynamics Group 2: conventional therapy	3 times per weeks for 6 weeks	Modified Ashworth Scale (MAS), Fugl Meyer Upper Extremity Scale (FMUE), goniometry, Action Research Arm Test	The result shows that neurodynamic combined with conventional treatment was more effective than conventional treatment alone to reduce spasticity, improve upper extremity function and AROM. The result also shows that there was significant improvement in upper extremity joint pain, sensation and PROM and no improvement occurred in coordination and fine task performance within groups. The study concludes that neurodynamic is effective for spasticity and has additional benefit in improving UE functional performance and active range of motion but the effects of neurodynamic

						combined with conventional treatment are no different than conventional treatment alone on passive range of motion, joint pain, coordination, fine task performance and sensation.
Kim M, Kim T[4]	Randomized controlled trial	N=26	Group A: Instrument assisted soft tissue mobilization (IASTM) Group B: Neural dynamic technique (NDYT)	6 weeks 5times per week	Balancia software, Mintosys Korea	The results suggest that IASTM is an effective method for decreasing the muscle tone and stiffness in acute stroke patients.
J. Anandhraj, A. Kumaresan 2020[12]	Quasi Experimental	N=20	All patients received Neurodynamic sliding technique (NDST)	4 weeks	Goniometer	NDST shows minimal observable significance in hemiplegic subjects. Hence this NDST should be practiced for long term effect.
Hyun-Kyu Cha, Hyuk-Shin Cho et. al 2014[13]	Randomized controlled trial	N=20	Group 1: Sciatic nerve mobilization with conventional physical therapy Group 2: Only conventional physical therapy	5 times a week for 4 weeks	Foot pressure test was used to measure the pressure distribution of the soles of the feet and disturbance in a standing position, two-dimensional imaging analyzer system,	The present study showed that sciatic nerve mobilization with conventional physical therapy was more effective for lower limb function than conventional physical therapy alone in patient with poststroke hemiparesis.

Jaemyoung Park, Jaeyun Cha et. al 2014[14]	cross-sectional study design	N=24	All patients received neurodynamic sciatic nerve sliding technique	One time study	Standardized Passive straight leg raise (SLR) test, Goniometer,	Application of the neurodynamic sciatic nerve sliding technique exhibited improved hamstring flexibility and postural balance of healthy adults.

Table 2- Risk of Bias of Included Studies (Yes, Low Risk of Bias; No, High Risk of Bias)

Citations	Adequate Sequence Generation?	Allocation Concealment ?	Blinding?	Incomplete Outcome Data Addressed?	Free of Selective Reporting?	Conclusions
N Zamurd, M Obaid Baig et. al 2022[11]	Yes	Yes	Yes	Yes	Yes	Low risk of bias
Kim M, Kim T[4]	Yes	Yes	Yes	Yes	Yes	Low risk of bias
J. Anandhraj, A. Kumaresan 2020[12]	No	No	No	Yes	Yes	High risk of bias
Hyun-Kyu Cha, Hyuk-Shin Cho et. al 2014[13]	Yes	Yes	Yes	Yes	Yes	Low risk of bias
Jaemyoung Park, Jaeyun Cha et. al 2014[14]	No	No	No	Yes	Yes	High risk of bias

Discussion:

This systematic review was done to analyze the effects of different neurodynamic interventions on spasticity in patients with stroke. All included studies showed positive effects on the gain of joint range of motion, lower limb functionality, decrease of myoelectric activity of the spastic muscle and reduction of pain and spasticity when combined with the application of neurodynamic intervention. Evidences from RCTs were used to examine the effectiveness of neurodynamic interventions on spasticity in stroke patients. In addition to above mentioned evidences, researchers mentioned below also proved physical therapy interventions to be equally effective for reducing the severity of spasticity and improving functional level in stroke patients. A total of five research articles on neurodynamic intervention for stroke patients are included in this review. Zamurd N et. al suggested that neurodynamic is effective for spasticity, upper extremity function and active range of motion[11]. Other study in 2016 showed that Neurodynamic therapy has been shown to lower tone, enhance range, and improve function in stroke patients[15]. In 2009 study stated that brain has ability to regenerate or transform by increasing axonal and dendritic sprouting as a result of which neuroplasticity occurs in central nervous system[16]. Other study in 2017 determined that Rhythmic Neurodynamic accelerated the nerve conduction velocity resulting in improvement in upper extremity function more than the general neurodynamic[17,18].

Conclusion

In short, the research included in the present study indicate beneficial effects of neurodynamic technique in the gain of range of motion, reduction of spasticity, improvement of myoelectric activity, increase of muscle flexibility and improvement in distribution of body weight and in the postural balance.

Disclosure statement:

No potential conflict of interest was reported by the authors.

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