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Review Article

Effect of Stretching Exercises on Spasticity in Stroke Patients-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 starching for patients with stroke. **Objective**: This systematic review aimed to investigate the effectiveness of stretching exercises on patients with stroke. **Method**: Five databases (PubMed, Cinahl, 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 168 patients, reporting on the subject of stretching exercises 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**: Stretching exercises seemed to be the most effective treatment to reduced spasticity. When it is appropriately targeted, it significantly improves flexibility and postural balance.
Keywords: 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 stretching exercise 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 Stretching exercise 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 2018 through 2021. Five databases (PubMed, Cinahl, 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 stretching exercise performed on patients with stroke. The intervention group (Stretching exercise) compared to a control group where another or no type of intervention has been performed.

Quality assessment

Quality of methodology of carefully chosen manuscripts was evaluated by PEDro Scale, containing of 11 questions in two phases. Questions from 1–9 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), Neural properties, H-reflex latency and Hmax/Mmax ratio, Frequency, percentage, paired t-test, and Wilcoxon sign rank test. Simplified upper limb Fugl-Meyer score (FMA) and modified Barthel index (MBI) Myoton pro.

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.

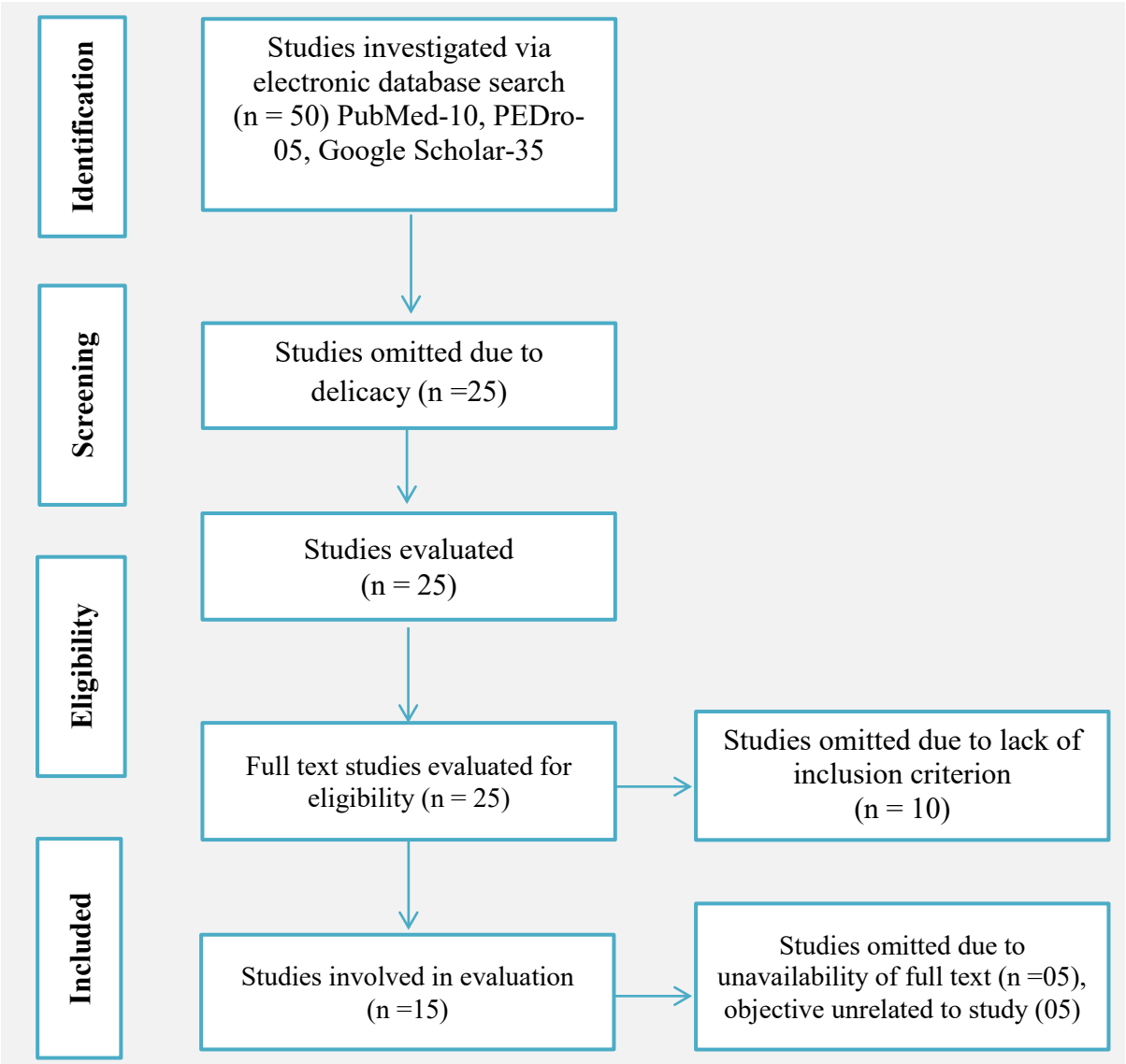

Figure 1. Flow chart displaying the selection of studies

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, four were RCTs[11,12,13,14], and one was Quasi experimental design study[4]. All studies were conducted between 2018 and 2021. Number of participants in the studies ranged from 20 to 56. All articles were experimental. Concerning the efficacy of results established in the most of the articles, stretching exercise was 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
Ghasemi et al[11].	Randomized controlled trial	N=45	Group 1: functional stretching Group 2: conventional therapy	3 times per weeks for 4 weeks with 2 months follow up	Neural properties, H-reflex latency and Hmax/Mmax ratio, Modified Ashworth Scale (MAS).	Results indicated that the use of functional stretching exercises can cause significant differences in neural and mechanical properties of spastic medial gastrocnemius muscle in patients with chronic stroke.
Tiparat et al[4].	Quasi Experimental	N=27	Hand stretching program	9 weeks	Frequency, percentage, paired t-test, and Wilcoxon sign rank test.	Results suggested that the hand stretching program using PVC pipe, to reduce hand spasticity of stroke patients in the rehabilitation phase at home. The result of the treatment program was satisfied in terms of faster recovery of hand spasticity condition, and it could also help patients to be able to take care of themselves at home after recovery.
Dafda et al[12].	Randomized controlled trial	N=20	Group 1: Static Stretching with conventional rehab Group 2: Hold-Relax with conventional rehab	3 weeks 3 sets per sessions	Modified Ashworth Scale (MAS).	Results show Hold-Relax is more effective than Static Stretching.
XU et al[13].	Randomized controlled trial	N=56	Group 1: Routine treatment and slow stretching training, extracorporeal shock wave Group 2: Pseudo-extracorporeal wave therapy	6 times a week for 4 weeks	Modified Ashworth scale (MAS), simplified upper limb Fugl-Meyer score (FMA) and modified Barthel index (MBI)	Slow stretching training combined with extracorporeal shock wave could effectively improve the post-stroke biceps brachii spasticity, and its therapeutic effect is better than the simple application of slow stretching training.

Youn et al[14].	Randomized controlled trial	N=20	Group 1: stretching exercise with far infrared Group 2: stretching exercise only	One time study	Myoton pro.	For stroke patients with spasticity, stretching exercises increased the ankle's range of motion and decreased the gastrocnemius muscle tone. The addition of heat therapy further increased the ankle's range of motion. On the other hand, as the sample size was small, future studies should include more subjects.

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
Ghasemi et al[11].	Yes	Yes	Yes	Yes	Yes	Low risk of bias
Tiparat et al[4].	Yes	Yes	Yes	Yes	Yes	Low risk of bias
Dafda et al[12].	No	No	No	Yes	Yes	High risk of bias
XU et al[13].	Yes	Yes	Yes	Yes	Yes	Low risk of bias
Youn et al[14].	No	No	No	Yes	Yes	High risk of bias

Discussion

This systematic review was done to analyze the effects of stretching exercises 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 stretching exercise. Evidences from RCTs were used to examine the effectiveness of stretching exercise 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 stretching exercise for stroke patients are included in this review. Ghasemi et al. suggested that stretching exercise is effective for spasticity, upper extremity function and active range of motion[11]. Other study in 2018 showed that stretching exercise has been shown to lower tone, enhance range, and improve function in stroke patients[5]. In 2017 Lundquist and Maribo 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[15]. 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[16,17].

Conclusion

In short, the research included in the present study indicate beneficial effects of stretching 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.

Declarations

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