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The immediate effects of specific-myofascial release technique versus Proprioceptive neuromuscular facilitation Hold-relax technique on hamstring flexibility in sub-acute and chronic stroke patients–An experimental study

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Abstract

Background: Flexibility is a key component of the physical fitness that enables the person to move smoothly and safely. In stroke, altered flexibility gives rise to alterations in the gait of an individual which affects the locomotion, ultimately which is a basic human necessity. Studies have shown that any shortening of hamstring group of muscles will lead to altered mobility of the spine & pelvis, also altering the gait of the individual. Separate studies have proven the positive effect of PNF on lower limb flexibility and the benefit of MFR using tennis ball in post-stroke patients. The aim of this study was to compare the immediate effect of specific-MFR and PNF hold-relax technique on hamstring flexibility in post-stroke patients.

Materials and methods: Thirty-two post-stroke subjects with mild to moderate hamstring tightness in the age group of 30 -75 years participated in this study. Group A received Specific-MFR in prone position with feet off the end of table for 120 seconds, while Group B received PNF Hold-Relax in supine with Hip-knee flexed to 90 degree and then extending the knee till barrier point followed by strong isometric contraction to the hamstrings for 6-10 seconds for 20 repetitions. Pre and Post Treatment popliteal angle was measured using the passive knee extension test.

Result: No significant results were found between both the groups indicating equal effectiveness of both the treatment techniques.

Conclusion: Our study supported the null hypothesis that is both, specific MFR and PNF technique of hold-relax have equal effects on improving hamstring flexibility in post stroke patients. Clinical Significance: According to the therapist either of the techniques can be applied based on patients' level of hamstring tightness.

Keywords: physiotherapy, post-stroke, flexibility, PNF hold relax, MFR

Introduction

Stroke is the sudden loss of neurological function caused by an interruption of the blood flow to the brain. Ischemic stroke is the most common type, affecting about 80% of individuals with stroke, and results when a clot blocks or impairs blood flow, depriving the brain of essential oxygen and nutrients. Haemorrhagic stroke occurs when blood vessels rupture, causing leakage of blood in or around the brain [1]. According to the current statistics in India, mortality rate due to stroke is expected to rise from 19% to 36% by the year 2030 [2]. An individual with stroke in the acute stages represents with hypotonia, difficulty or inability to move one side of the body and rarely comatosed state due to neurological shock which later is represented as hypertonia, tightness leading to decrease in flexibility which limits range of motion, thus leading to activity limitations and gait abnormalities. Flexibility is a key component of the physical fitness that enables the person to move smoothly and safely. Altered flexibility gives rise to alterations in the gait of an individual which affects the locomotion, ultimately which is a basic human necessity [3]. Emerging evidences suggests that hamstring tightness contributes to musculoskeletal dysfunctions such as impaired postural balance, reduced range of motion of the knees and hips, increased risk of musculoskeletal and soft tissue injuries as patella tendinopathy, patellofemoral pain, hamstring strain injury, low back pain, herniated lumbar disc, decreased lumbar lordosis, decreased range of lumbar spine flexion and a higher risk of muscle injury thus causing an inefficiency in the workplace [4]. Although the flexibility of all the muscles of the body is essential for normal human function, the flexibility of hamstring muscle is much emphasized because during the stance phase the hamstrings acts to stabilize the pelvis thus helping the body propel forward, whereas they help in flexing the knee during the swing phase of the gait cycle [5]. A majority of individuals who have suffered stroke are later able to walk, though rarely with a normal pattern [6]. For this group of individuals, posture, tone and coordinate reciprocal movements, which are required for normal gait, are usually impaired [7] and gait reeducation is a major component of physical therapy intervention for these patients [8]. Therefore, it continues to remain a major public health and disability concern. Studies have shown that any shortening in this group of muscles will lead to altered mobility of the spine and pelvis, also altering the gait of the individual [9, 10]. Various Physiotherapy interventions are available for improving the flexibility like static stretching, ballistic stretching, cryostretching, Myofascial release (MFR), foam rolling, Neurodynamic technique, proprioceptive

neuromuscular facilitation technique (PNF), Muscle Energy Technique [11, 12, 13]. Proprioceptive neuromuscular facilitation (PNF) is one of the major therapeutic approaches aimed at improving the important features necessary for the functional ambulation of hemiplegic patients, such as muscular tone, strength and flexibility. Inclusion of PNF in any treatment plan for post-stroke individuals may be of benefit, especially when improved flexibility and functional ambulation is a key part of treatment goals. Since the improvement in gait speed (reduced task-completion time) – obtained with the PNF treatment – has been found to be positively-related to many spatiotemporal gait parameters and improvements in other muscular characteristics and functional activities, clinicians are likely to include PNF in treatment plans to obtain these added values.[14]

Four theoretical physiological mechanisms in PNF were identified for increasing ROM: autogenic inhibition, reciprocal inhibition, stress relaxation, and the gate control theory. (1) Autogenic Inhibition: Autogenic Inhibition is what occurs in a contracted or stretched muscle in the form of a decrease in the excitability because of inhibitory signals sent from the GTOs of the same muscle. (2) Reciprocal Inhibition: Reciprocal inhibition is what occurs in the TM when the opposing muscle is contracted voluntarily in the form of decreased neural activity in the TM. (3) Stress Relaxation: Stress relaxation is what occurs when the musculotendinous unit (MTU), which involves the muscles and the connected tendons, is under a constant stress. (4) The Gate Control Theory: The gate control theory is what occurs when two kinds of stimuli, such as pain and pressure, activate their respective receptors at the same time

PNF is a stretching technique utilized to increase ROM and flexibility. PNF increases ROM by increasing the length of the muscle and increasing neuromuscular efficiency. PNF stretching has been found to increase ROM in trained, as well as untrained, individuals. Effects can last 90 minutes or more after the stretching has been completed

Funk *et al*. assessed the efficacy of PNF stretching versus static stretching on hamstring flexibility performed with or without exercise in a study of 40 undergraduate student athletes. Each stretching method was performed for five minutes after 60 minutes of exercise or no exercise. The results showed that those who exercised and received PNF stretching experienced more of an increase in flexibility when compared to the baseline group and the group without exercise and PNF. [15]

Myofascial therapy can be defined as "the facilitation of mechanical, neural and psycho physiological adaptive potential as interfaced by the myofascial system". [16] The purpose of deep myofascial release is to release restrictions (barriers) within the deeper layers of fascia. This is accomplished by a stretching of the muscular elastic components of the fascia, along with the crosslinks, and changing the viscosity of the ground substance of fascia. [17]

Direct bodily effects range from alleviation of pain, improvement of athletic performance, and greater flexibility and ease of movement to more subjective concerns such as better posture [18]

The direct MFR method works directly on the restricted fascia. The practitioners use knuckles, elbows, ulnar border of the hands, fist or other tools to slowly sink in to the restricted fascia applying few kilograms force or tens of Newton and stretch the fascia. Direct MFR seeks for changes in the myofascial structures by stretching, elongation of the fascia, or mobilizing adhesive tissues. [19]

Even though there are ample of literature on rehabilitation post stroke, there is hardly any which give us enough evidence as well as the best treatment approach to fasten recovery and to limit the long-term disability in these individuals due to limited flexibility.

Aim: To study the immediate effects of specific-myofascial release technique versus Proprioceptive neuromuscular facilitation Hold-relax technique on hamstring flexibility in sub-acute and chronic stroke patients.

Objectives:

1. To find out the effects of Myofascial release technique on Hamstring flexibility in post stroke patients.
2. To find out the effects of PNF hold-relax on Hamstring flexibility in post stroke patients.
3. To assess popliteal angle pre and post treatment.
4. To compare the effects of Myofascial release technique and proprioceptive neuromuscular technique of Hold Relax on Hamstring flexibility.

Materials and Methods

An ethical approval was taken by the ethical committee of the institution before undertaking the study and a written consent was taken from the subjects explaining the entire procedure of the study before recruiting them in the study.

Study design: Pretest-Posttest Experimental Design

Sample size: A total of 32 subjects were recruited in the study, with 16 subjects in each group. Sample size was calculated considering an allowable error of 20% with the confidence interval set at 95% by the following formula based on the results:

Inclusion criteria

- Age group: >30 to < 75
- Early sub-acute (7 days – 3 months) to chronic stroke (> 6 months)
- Patients who are willing to participate.
- Mild to Moderate hamstring tightness (Passive Knee extension test)
- MMSE (Score:24-30)

Exclusion criteria

- Presence of any contractures.
- Any recent surgical intervention to the spine or the affected lower extremity.
- Any sensory impairments in the lower extremities.

Randomisation

Setting and location of the study: Tertiary care hospital and private hospitals

Allocation: Subjects were allocated in the groups of MFR and PNF respectively by using the chit method.

Implementation: The method of randomisation and allocation of the samples in the study was done by the researchers themselves.

Procedure

- MFR for Hamstrings- Subjects recruited in this group were placed prone with feet off the end of the table. A specific stretch with a gentle and sustained pressure is given to the hamstrings for 90-120 seconds.
- Subjects recruited in this group were placed in supine with hip-knee flexed to 90 degrees and then extending

the knee so as to take it to the barrier point followed by a strong isometric contraction to the hamstrings where the subject was asked to push the heel down on the examiners hand with maximal force and then passively extending the knee and then repeating the same procedure, each hold period lasted for 6-10 seconds followed by a relaxation phase of 10-15 seconds for 20 repetitions.

- During the entire treatment procedure, the subjects in both the groups were asked not to hold the breath. Both the intervention techniques were performed first and then the existing planned treatment protocols of the subjects were carried out. This study was a one session study, where immediate effects were studied by comparing the outcome measure before commencing the treatment and after the termination of the treatment.
- Outcome measures: Popliteal angle of the knee was measured with patient lying in supine pre and post the treatment. With the subject lying in supine and hip-knee flexed to 90 degrees, the knee was extended passively and the degree of excursion was measured using goniometry.

Statistical analysis

Statistical analysis was done using the software SPSS16. Paired T test was used to analyse the intra-group results whereas Unpaired T test was used to analyse the inter-group results.

Results

SPSS software was used for statistical analysis, the mean value for the MFR group was found to be 53.8750 pre-treatment and 60.5000 post treatment with a standard deviation of 4.25637 and 4.04969 respectively whereas for the PNF group the mean value pre and post treatment was found to be 52.1250 and 61.9375 with the standard deviation of 5.08429 and 5.03943 respectively. When the intra group results were analysed using the Paired T test, the results found were extremely significant with p value being 0.0001 respectively suggesting both the treatment techniques are highly reliable. However, when the inter-group results were analysed using the Unpaired T test, the results found were considered not significant with p value being 0.3808 suggesting that both the treatment techniques have equal therapeutic effects and thus proving the null hypothesis of the study.

Fig 1

Fig 2

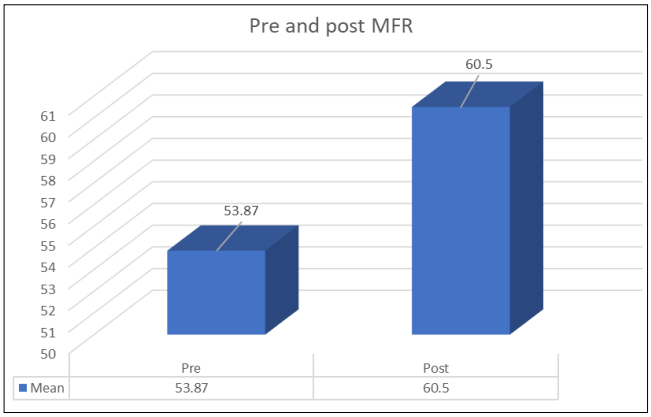

Fig 3

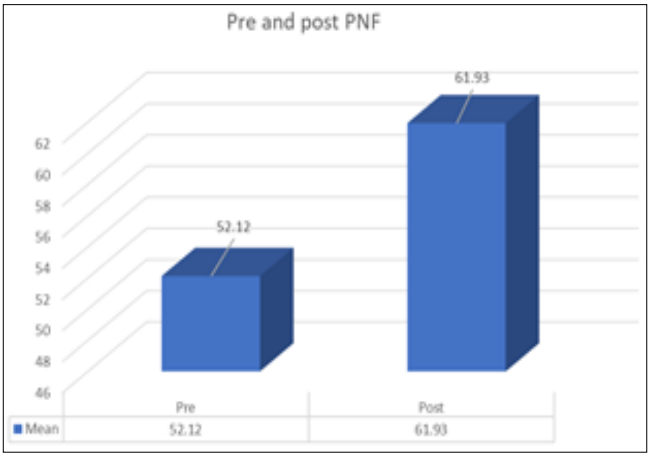

Fig 4

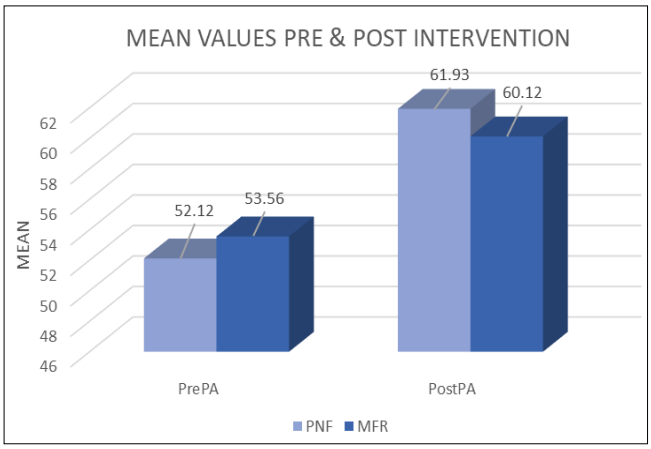

Fig 5

Discussion

A total of 32 subjects were recruited in the study, which were divided in two groups with 16 in each group. Group A was given specific myofascial release and Group B was given Hold-relax technique in addition to the set treatment protocols. Popliteal angle was measured before commencing the treatment and after the termination of the treatment. The mean of the pre and post values were compared using a Paired T test for intra-group results and an Unpaired T test for inter-group result. The results were found to be extremely significant within the groups (p=0.0001) respectively and not significant in between the groups (p=0.3808) suggesting both have equal treatment effects. The study was done over a short course of time considering only one treatment session.

PNF seems to have worked based on the following mechanisms: - Autogenic inhibition, stress relaxation and gate control theory. Each theoretical mechanism focuses on the Golgi tendon organ. The golgi tendon organs when subjected to a strong isometric contraction and later stretched sense as a harmful stimulus to the body and shows result later as a result of protective mechanism of the body. The PNF stretching technique increases joint range of motion by performing voluntary muscle contraction and promoting muscle relaxation before stretching in order to reduce the reflexive components which cause muscle contraction. Autogenic inhibition works as a result of self-regulatory mechanism in order to protect other structures. It occurs in the contracted/stretched muscle where a decrease in motor excitability is seen because of inhibitory signals sent from the stretched or the contracted muscles.

As age increases, the soft tissues that are usually affected by PNF methods and receive the neural inhibition produced by PNF to reduce reflex activity and promote relaxation, which leads to greater ROM, are changed. The soft-tissue matrices tend to lose elasticity and strength, and myofibrils are replaced by connective tissue. (Feland *et al*., 2001). This becomes a concern in the geriatric population [15].

While, myofascial release is a hands-on soft tissue technique that facilitates a stretch into the restricted fascia. A sustained pressure is applied into the restricted tissue barrier; after 90-120 seconds the tissue will undergo histological length changes allowing the first release to be felt. The therapist follows the release into a new tissue barrier and holds. The restoration of length and health to the myofascial tissue will take the pressure off the pain sensitive structures such as nerves and blood vessels, as well as restoring alignment and mobility of the joints [20]. Muscle and fascia are functionally linked (myofascia) combining the properties of contractile and non-contractile tissue. Fascial function has been largely underestimated. Fascia not only provides contour to the body but also provides lubrication between structure for movement (muscle play) and nutrition. Myofascial Release recognizes that a muscle cannot be isolated from other structures of the body. Fascia covers all structures of the body, including muscles and their individual myofibrils. Therefore, all "muscle stretching" is actually stretching of myofascial units. Asymmetrical soft tissue tightness and restrictions can cause pain proximal to or distal to the area of the actual dysfunction. Myofascial Release removes tightness and restrictions that impede efficient movement.[16] Such improvements are seen probably due to a stretching of the elastic component, a shearing of cross-links that can develop at nodal points of the fascia, and a change in the viscosity of the ground substance from a more solid to a gel state. This change in viscosity increases the production of hyaluronic acid and increases the glide of the fascial tissue. It is regularly observed what appears to be a positive effect on the spindle cells, golgi tendon organs of the musculotendinous component, and the tone of the peripheral, autonomic, and central nervous system. Treatment with Myofascial Release disrupts the patient's homeostasis. This disruption of the patients' homeostasis is the result of the effect of myofascial Release on the central nervous system. Thus, based on the above pathophysiology both the treatment methods have had similar effect on increasing hamstring flexibility in stroke subjects [21].

Study done by Jihye Junga, Wonjae Choi *et al* have shown the immediate effect of self-myofascial release on hamstring flexibility in chronic stroke patients [12]. Similarly, study done by Co Akosile, OE Johnson *et al*. showed positive effects of Proprioceptive Neuromuscular Facilitation Technique on the Functional Ambulation of Stroke Survivors with much significance [10].

Thus, the current study suggests that the therapist has to discreetly choose between the given techniques while planning rehabilitation of these patients as it gives us similar treatment effects.

Conclusion

Our study supported the null hypothesis i.e., Both, specific MFR and PNF technique of hold-relax have equal effects on improving hamstring flexibility in post stroke patients. Clinical Significance: According to the therapist either of the techniques can be applied based on patients' level of hamstring tightness.

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