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**A STUDY TO COMPARE THE IMMEDIATE EFFECT OF PNF
STRETCHING VERSUS DEEP STRIPPING MASSAGE WITH
ECCENTRIC RESISTANCE FOR IMPROVING CALF MUSCLE
FLEXIBILITY IN NURSES – A COMPARATIVE STUDY**

PANCHAL V^{1*}, GUJJAR V² AND PATEL G³

1: MPT Scholar, Physiotherapy, Ahmedabad Physiotherapy College, Parul University, Gujarat, India

2: Assistant Professor, Physiotherapy, Ahmedabad Physiotherapy College, Parul University,
Gujarat, India

3: Principal, Head of Department, Ahmedabad Physiotherapy College, Parul University, Gujarat,
India

***Corresponding Author: Dr. Vaishnavi Panchal: E Mail: ypanchal0505@gmail.com**

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ABSTRACT

Aim and Objective: This study seeks to examine immediate impacts of Proprioceptive Neuromuscular Facilitation compared to Deep Stripping Massage with Eccentric Resistance technique on flexibility of calf muscles in nurses.

Method: The study involved 86 participants who met the inclusion criteria and were divided into two groups, each comprising 43 individuals. Group A received Proprioceptive Neuromuscular Facilitation (PNF) technique, while Group B received Deep Stripping Massage with Eccentric Resistance (DSMER) technique. Calf flexibility was assessed before and after the intervention using measures including Dorsiflexion Range of Motion (ROM) in Modified Root Positions 1 & 2 for both right and left sides, Weight Bearing Lunge Test for both right and left sides, and Foot & Ankle Ability Measure scores.

Results: The data was analyzed using SPSS 26.0 with a significance level of $p < 0.05$. Normality was assessed using the Shapiro-Wilkinson test. Wilcoxon Sign Rank test was used for within-group analysis, while Mann Whitney U test was used for between-group analysis. Group A showed greater improvements than Group B in measures of MRP 1, MRP 2, and WBLT. However, both groups showed similar enhancements in FAAM scores.

Conclusion: This study concludes that PNF technique as well as DSMER technique is found to improve calf muscle flexibility, but PNF technique was found superior than DSMER technique.

Keywords: Calf flexibility, PNF, Deep Stripping Massage, Eccentric Resistance, Dorsiflexion ROM

INTRODUCTION

The musculoskeletal system includes bones, skeletal muscles, cartilage (like articular cartilage, intervertebral discs, and menisci), fibrous tissues such as tendons, ligaments, and joint capsules, as well as fat tissue [1]. The muscular system consists of muscle fibers, specialized cells primarily responsible for contraction. Muscle tightness is a prevalent issue among healthy individuals, with calf muscle tightness being a common occurrence [2]. Muscle flexibility refers to a muscle's capacity to extend, enabling movement through a range of motion in one or multiple joints. Reduced flexibility is characterized by a decline in a muscle's ability to stretch [3]. Approximately 88% of forefoot and ankle issues stem from tightness and contractures in the gastrocnemius muscle [4].

Plantar flexion, crucial for walking and running, is achieved by the gastrocnemius and soleus muscles. When standing, gravity can lead to forward tipping at the ankle joint, but the soleus and gastrocnemius muscles prevent this through their activity [5]. Nurses, due to extended periods of standing and walking, experience

a higher rate of musculoskeletal disorders (MSDs) compared to other professions [6].

The notion of "standing environments" encompasses the concepts of prolonged standing and walking, creating a challenging context within the nursing profession, particularly concerning foot health^[6]. Nurses frequently work on concrete and hard surfaces, requiring extended periods of standing and walking. Given the physically demanding nature of their job, maintaining optimal foot health is crucial for nurses to perform effectively. Lower extremity and foot health significantly contribute to their overall well-being [7].

Physical therapists employ various techniques to preserve and enhance joint mobility, preventing deformities and dysfunction caused by muscle contractures. Their aim is to elongate the musculotendinous unit, support connective tissue, and expand the range of motion [3]. Enhancing flexibility through stretching is a fundamental principle of physical fitness [2]. Different stretching methods include static, dynamic, ballistic, and PNF techniques [4]. Additional methods utilized

include massage, eccentric training and cryotherapy [3].

PNF stretching includes passive and active techniques. In passive methods like "contract-relax" or "hold-relax," the muscle is stretched, followed by a static contraction before being stretched further. In the active technique, "contract-relax-antagonist-contract," the antagonist muscle is contracted instead of the final passive stretch. Both methods increase range of motion (ROM) [8].

Deep Stripping Massage (DSM) is a technique used to lengthen muscles by applying pressure with the thumb along their length, aiming to release trigger points and tightness. It's vital to execute DSM slowly and intentionally to effectively target the muscle. To increase pressure, one can use a thumb along with a couple of fingers from the other hand. It's crucial to avoid causing pain during DSM. Incorporating eccentric training into flexibility enhancement involves both strengthening and stretching muscle tissues. When paired with DSM, eccentric resistance can significantly enhance muscle flexibility [3, 9].

Several studies indicate that PNF stretching and deep stripping massage with eccentric resistance are more effective than static stretching for improving calf flexibility. Thus, this study aims to compare the immediate effects of these techniques on nurses.

MATERIALS AND METHODS

This study was a comparative study aiming to investigate the comparison between PNF stretching versus Deep stripping massage with eccentric resistance in order to increase calf muscle flexibility among nurses of Health 1 super speciality hospital (Shilaj, Ahmedabad) and Amba health centre & Hospital (Adalaj, Gandhinagar). The study involved 86 participants who underwent a treatment session.

The materials used in the study were Goniometer, Inch tape, Theraband (Green), Massage powder, Plinth, Stopwatch and Stationary. There were 3 outcome measures used immediately pre and post the intervention. It included Ankle Dorsiflexion ROM in 2 positions, with knee extended (Modified Root Position 1, MRP-1) & with knee 90 degrees flexed (Modified Root Position 2, MRP-2) [3, 10, 11], Weight Bearing Lunge test [12] and Foot Ankle Ability Measure- ADL subscale [6, 13, 14].

Study included individuals within the age of 25-39 years of both the genders with the ADFROM < 15 degrees with knee fully extended, bilateral calf tightness, flat feet and standing for nearly 8 hrs per day [2, 3, 5, 15, 16]. Participants with any musculoskeletal, neurological impairments, fractures and deformity of lower limb, spine fracture or surgery, varicose veins and ankle edema were excluded [2, 3].

Interventions

PNF Stretching Technique

The patient was lying supine with his leg straight. The leg was manipulated by the therapist in the dorsiflexion direction until it became uncomfortable. "Try to take your foot up, against my resistance, using your maximal strength," was the instruction given at this stage when the isometric contraction of the limiting muscle was held. The therapist used just enough pressure to keep the foot still. Neither the patient nor the therapist intended any motion. This marked as initiation of 20-sec hold time. After therapist had sustained contraction long enough, Before repeating the procedure, the patient was instructed to calm down and the foot was passively moved to the new limit of range. Next, by placing foot passively to next barrier, process was repeated. During the session, this entire process was carried out three times [2].

Deep Stripping Massage with Eccentric Resistance Technique

On treatment table, the patient was placed in a prone posture. To measure the subject's midfoot, a green theraband, or elastic resistance band, was wrapped around it. To make sure that during the intervention there was constant ER across the whole ROM, band's free end was secured to plinth and adjusted. The subject's calf muscle was then lightly smeared with a small amount of massage powder. Massage strokes were

administered along the subject's calf muscles using deep longitudinal stripping technique. This involved applying pressure with both thumbs in a series of overlapping strokes, repeating approximately ten times. Patient directed for full DFROM while the massage was being administered. The subject was requested to provide input by the therapist regarding the pressure, adjustment, and force used in each stroke during the process [3].

STATISTICAL ANALYSIS

Data was analysed using SPSS 26.0 and level of significance was set at $p < 0.05$. Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using Shapiro Wilkinson test. Inferential statistics to find out the difference within the group was done using Wilcoxon Sign Rank test and between group analysis was done using Mann Whitney U test. Chi Square test was used to find the difference in proportion.

RESULTS

In this Study 86 nurses between the age of 25-39 years were included. In group A, 13-males & 30-females were there. In group B, 9-males and 34-females. Group A received Proprioceptive Neuromuscular Facilitation technique and group b received DSMER technique.

In terms of "Mean age," the Mann Whitney U test didn't reveal a significance

difference ($P>0.05$) between the groups (**Table 1**).

In terms of "Gender," the Chi square test between-group analysis didn't reveal a significance difference in the proportion of gender ($P>0.05$) (**Table 2**).

Concerning the "MRP-1 Right test," The Mann Whitney U Test revealed a statistically significance difference between the groups at the post-interval ($P<0.05$). Wilcoxon Sign Rank test was used for within-group analysis, and the results showed a significance difference ($P<0.05$) between group a and group b. group a's mean difference (PRE-POST) was larger than group b's ($3.67>1.51$) (**Table 3**).

Regarding 'MRP-1 Left test', A statistically significant difference was detected at the post-interval ($P<0.05$) in the group analysis conducted using the Mann Whitney U test. Wilcoxon Sign Rank test was used for within-group analysis, and the results showed a significant difference ($P<0.05$) between group a and group b. The mean difference (PRE-POST) between group a and group b was greater in group a ($3.72>1.6$) (**Table 4**).

Concerning the "MRP-2 Right test," The Mann Whitney U Test revealed a statistically significant difference between the groups at the post-interval ($P<0.05$). Wilcoxon Sign Rank test was used for within-group analysis, and the results showed a significant difference ($P<0.05$)

between group a and group b. The mean difference (PRE-POST) between group a and group b was greater in group a ($3.65>1.98$) (**Table 5**).

Concerning the "MRP-2 Left test," The Mann Whitney U Test revealed a statistically significant difference between the groups at the post-interval ($P<0.05$). Wilcoxon Sign Rank test was used for within-group analysis, and the results showed a significant difference ($P<0.05$) between group a and group b. group a's mean difference (PRE-POST) was larger than group b's ($3.65>1.61$) (**Table 6**).

With reference to "Weight Bearing Lunge Test-Right," A statistically significant difference during the pre/post interval was not found in the group analysis using the Mann Whitney U Test ($P>0.05$). group a showed a significant difference ($P<0.05$) in the within-group analysis conducted using the Wilcoxon Sign Rank test. The mean difference (PRE-POST) between group a and group b was greater in group a ($1.02>0.6$) (**Table 7**).

In reference to the "Weight Bearing Lunge Test-Left," The Mann Whitney U Test between group analysis did not reveal a statistically significant difference at the pre/post interval ($P>0.05$). Wilcoxon Sign Rank test was used for the within-group analysis, and the results showed that group a alone had a significant difference ($P<0.05$). The mean difference (PRE-POST) between

group a and group b was greater in group a (0.94>0.7) (**Table 8**).

With respect to the "Foot & Ankle Ability Measure Score," The Mann Whitney U Test between group analysis did not reveal a statistically significant difference at the pre/post interval (P>0.05). Wilcoxon

Sign Rank test was used for within-group analysis, and the results showed a significant difference (P<0.05) between group a and group b. group a's mean difference (PRE-POST) was larger (4.62>4.37) than group b's (**Table 9**).

Table 1: Mean and SD values of Age in Group A & Group B

	Group A	Group B	Z Value	P Value
Mean	30.37	30.95	0.70	0.48
SD	4.04	3.59		

Table 2: Gender distribution in Group A & Group B

	Group A	Group B	X ² Value	P Value
Male	13(30.2%)	9(20.9%)	2.59	0.11
Female	30(69.8%)	34(79.1%)		

Table 3: Between and Within Group comparison of MRP-1 Right

	Pre	Post	Wilcoxon Sign Rank Test	P Value	Difference
Group A	9.86±2.52	13.53±3.12	6.01	0.0001*	3.67±2.82
Group B	9.46±2.11	10.97±2.58	2.97	0.003*	1.51±2.32
Mann Whitney U Test	0.79	4.14			
P Value	0.42	0.0001*			

Table 4: Between and Within Group comparison of MRP-1 Left

	Pre	Post	Wilcoxon Sign Rank Test	P Value	Difference
Group A	9.97±2.27	13.69±3.15	6.28	0.0001*	3.72±2.98
Group B	9.65±2.40	11.25±2.45	3.05	0.003*	1.6±2.42
Mann Whitney U Test	0.63	4.009			
P Value	0.52	0.0001*			

Table 5: Between and Within Group comparison of MRP-2 Right

	Pre	Post	Wilcoxon Sign Rank Test	P Value	Difference
Group A	13.18±2.60	16.83±1.54	5.44	0.0001*	3.65±2.98
Group B	13.76±3.52	15.74±1.66	2.55	0.01*	1.98±3.59
Mann Whitney U Test	0.86	1.85			
P Value	0.38	0.03*			

Table 6: Between and Within Group comparison of MRP-2 Left

	Pre	Post	Wilcoxon Sign Rank Test	P Value	Difference
Group A	13.09±2.89	16.74±1.87	4.95	0.0001*	3.65±3.23
Group B	14.18±3.67	15.79±1.83	1.99	0.04*	1.61±3.70
Mann Whitney U Test	1.53	1.76			
P Value	0.12	0.04*			

Table 7: Between and Within Group comparison of WBLT Right

	Pre	Post	Wilcoxon Sign Rank Test	P Value	Difference
Group A	10.70±1.50	11.72±1.41	3.24	0.001*	1.02±1.45
Group B	11.29±2.21	11.89±2.30	1.23	0.22	0.6±2.25
Mann Whitney U Test	1.44	0.41			
P Value	0.15	0.68			

Table 8: Between and Within Group comparison of WBLT Left

	Pre	Post	Wilcoxon Sign Rank Test	P Value	Difference
Group A	10.75±1.52	11.69±1.32	3.06	0.003*	0.94±1.41
Group B	11.53±2.31	12.23±2.47	1.35	0.17	0.7±2.38
Mann Whitney U Test	1.84	1.26			
P Value	0.06	0.209			

Table 9: Between and Within Group comparison of FAAM

	Pre	Post	Wilcoxon Sign Rank Test	P Value	Difference
Group A	80.13±5.52	84.75±5.07	4.04	0.0001*	4.62±5.43
Group B	81.18±5.35	85.55±5.40	3.76	0.0003*	4.37±5.37
Mann Whitney U Test	0.89	0.70			
P Value	0.37	0.48			

DISCUSSION

PNF stretching methods target active elements that restrict movement. In a specific PNF technique called hold-relax, neural inhibition reduces reflex activity. This involves an inhibitory neuron decreasing activity in the α -motoneurons of the opposing muscle, leading to muscle relaxation and reduced resistance to stretching. PNF stretching incorporates both active muscle contraction and neuromuscular reflexes, which lower resistance to stretching. The resulting muscle relaxation from PNF techniques can influence blood flow. PNF may boost motor activity, affecting vascular function. Increased muscle activation might prompt the release of substances that dilate blood vessels, enhancing flexibility and reducing

tightness [17]. Panchal A et al suggests, Stretching with PNF & static stretching both work well to increase calf muscle flexibility. But studies show that PNF stretching improves calf muscle flexibility more than static stretching does [2].

Thus, results of this study corresponds with other published studies on this matter highlighting the efficacy of PNF stretching technique for improving calf flexibility. It might be improved because of the fact that PNF stretching techniques may target muscle tightness by utilizing neural inhibition to reduce reflex activity, resulting in muscle relaxation and enhanced flexibility.

In 2016, Sudhakar and colleagues conducted a study comparing the effect of

DSMER to constant stretch with Cryotherapy in enhancing flexibility of calf. This research involved 30 collegiate male athletes who underwent screening for calf muscle flexibility, after which eligible participants were identified. The findings revealed a substantial contrast in post-intervention DFROM & scores on FAAM subscale between Group A, which underwent DSMER, and group b, which received constant stretching & cryotherapy, with a p-value of 0.001 or lower. This indicates that the intervention employing DSMER resulted in high significant enhancements of Calf muscle flexibility compared to static stretching with cryotherapy [3].

The results of this intervention align with findings previously reported by other researchers which says that Deep stripping massage is a specialized massage method designed to address deep-seated tension within muscles and fascia, promoting relaxation and alleviating tightness. Integrating eccentric resistance involves stretching muscles while they are resisting force, which has the potential to stimulate muscle development and enhance flexibility. This combination technique targets both superficial and deep muscle layers, aiming to improve overall muscle function and flexibility by addressing tension and promoting elongation under resistance.

Therefore, this study demonstrates that both the Proprioceptive Neuromuscular Facilitation (PNF) technique and the Deep Stripping Massage with Eccentric Resistance technique effectively enhance calf muscle flexibility. However, the PNF technique was identified as superior to DSMER technique in terms of improving Calf muscle flexibility. This suggests that while both approaches yield positive results, the PNF technique may offer greater benefits for enhancing flexibility in the calf muscles.

CONCLUSION

This study demonstrates that Group A, which underwent Proprioceptive Neuromuscular Facilitation technique, exhibited greater enhancements compared to Group B, which received Deep Stripping Massage with Eccentric Resistance technique, in measures of MRP 1, MRP 2, and WBLT. However, both interventions yielded similar improvements in FAAM scores. Consequently, while both techniques effectively enhance calf muscle flexibility, PNF technique emerges as superior due to its notable enhancements across multiple outcome measures.

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REFERENCES

- [1] Boros K, Freemont T. Physiology of ageing of the musculoskeletal system. *Best practice & Research Clinical Rheumatology*. 2017 Apr 1;31(2):203-17.
- [2] Panchal A, Sabhaya D, Maitri P. Effect Of Pnf Stretching Versus Static Stretching On Calf Muscle Flexibility: A Comparative Experimental Study. *Int J Physiother Res*. 2019;7(1):2980-83.
- [3] Sudhakar S, Nathan CS. Effects of Deep Stripping Massage with Eccentric Resistance versus Static Stretch with Cryotherapy on Improving Calf Muscle Flexibility. *TJPRC: International Journal of Physiotherapy & Occupational Therapy (TJPRC: IJPOT)*. 2016;2:45-50.
- [4] Adhye Y. Immediate effect of MET vs Static Stretching on Tendo–Achilles Tightness.
- [5] Sarkar A, Gupta N. Impact of Gender on Calf Muscle Tightness A Comparitive and Normotive Study.
- [6] Bernardes RA, Parreira P, Sousa LB, Stolt M, Apóstolo J, Cruz A. Foot disorders in nursing standing environments: a scoping review protocol. *Nursing Reports*. 2021 Jul 21;11(3):584-9.
- [7] STOIT M, SuHONeN R, Virolainen P, Leino-Kilpi H. Lower extremity musculoskeletal disorders in nurses: A narrative literature review. *Scandinavian Journal of Public Health*. 2016 Feb;44(1):106-15.
- [8] Konrad A, Gad M, Tilp MJ. Effect of PNF stretching training on the properties of human muscle and tendon structures. *Scandinavian Journal of Medicine & Science in Sports*. 2015 Jun;25(3):346-55.
- [9] O'Sullivan K, McAuliffe S, DeBurca N. The effects of eccentric training on lower limb flexibility: a systematic review. *British Journal of Sports Medicine*. 2012 Sep 1;46(12):838-45.
- [10] Rowlett CA, Hanney WJ, Pabian PS, McArthur JH, Rothschild CE, Kolber MJ. Efficacy of instrument-assisted soft tissue mobilization in comparison to gastrocnemius-soleus stretching for dorsiflexion range of motion: A randomized controlled trial. *Journal of Bodywork and Movement Therapies*. 2019 Apr 1;23(2):233-40.
- [11] Boone, D. C., Azen, S. P., et al., 1978. Reliability of goniometric measurements. *Phys Ther*. 58 (11), 1355-1360.
- [12] Konor MM, Morton S, Eckerson JM, Grindstaff TL. Reliability of three

- measures of ankle dorsiflexion range of motion. *International journal of sports physical therapy*. 2012 Jun;7(3):279.
- [13] Burcal CJ, Chung S, Johnston ML, Rosen AB. Does the method of administration affect reliability of the foot and ankle ability measure?. *Journal of sport rehabilitation*. 2020 May 1;29(7):1038-41.
- [14] Martin RL, Irrgang JJ, Burdett RG, Conti SF, Swearingen JM. Evidence of validity for the Foot and Ankle Ability Measure (FAAM). *Foot & ankle international*. 2005 Nov;26(11):968-83.
- [15] Waters TR, Dick RB. Evidence of health risks associated with prolonged standing at work and intervention effectiveness. *Rehabilitation Nursing*. 2015 May;40(3):148-65.
- [16] Mohamed SH, ALanni EF, Faggal MS, Ibrahim MM. Prevalence of Calf muscle tightness in asymptomatic flat foot subjects. *Egyptian Journal of Physical Therapy*. 2022 Jun 1;10(1):26-31.
- [17] Ghanbari A, Ebrahimian M, Mohamadi M, Najjar-Hasanpour A. Comparing hold relax-proprioceptive neuromuscular facilitation and static stretching techniques in management of hamstring tightness. *Indian journal of physiotherapy and occupational therapy*. 2013;7(1):126.