

Effectiveness of Proprioceptive Neuromuscular Facilitation Versus Proprioceptive Neuromuscular Facilitation with Metronome on Upper Limb Spasticity in Stroke Patients: A Randomized Control Trial.

Harshali D. Dixit¹, Dr. Varsha A. Kulkarni²

¹Undergraduate Student, Bachelor of Physiotherapy LSFPEF's College of Physiotherapy, Pune, Maharashtra, India

²Principal and Professor, Neuro Physiotherapy Department, LSFPEF's College of Physiotherapy, Pune, Maharashtra, India

Abstract—Stroke often results in upper limb spasticity and functional limitations; spasticity is major challenge to the rehabilitation team. The present study compared the effectiveness of PNF with metronome beats versus PNF alone in upper limb spasticity in stroke patients. A randomized controlled trial was conducted on 30 stroke patients over four weeks. The result showed that functional performance improved significantly in the metronome group, while spasticity changes were minimal. Thus, the study concludes PNF combined with metronome beats improves upper limb functional performance.

Index Terms—stroke, upper limb, spasticity, PNF, metronome

I. INTRODUCTION

Stroke leads to upper motor neuron lesions causing spasticity and impaired motor control. Upper limb dysfunction significantly affects activities of daily living. PNF is widely used in rehabilitation to improve motor control, strength, and coordination. It's particularly effective in reducing spasticity and improving functional outcomes. Metronome rehabilitation exercises have been shown to improve timing, rhythm, and motor control, potentially enhancing the effectiveness of traditional therapies like PNF. Thus, it is important to check the combined effects of metronome and PNF on upper limb spasticity in stroke patients to introduce it for rehabilitation.

II. AIM

To compare the effect of PNF with metronome beats versus PNF alone on upper limb spasticity and functional performance in stroke patients.

III. OBJECTIVES

1. To assess upper limb spasticity before and after intervention.
2. To assess upper limb functional performance before and after intervention.
3. To compare the effectiveness of both interventions.

IV. METHODOLOGY

Study Design: Randomized controlled trial.

Type of study: Experimental study

Sample Size: 30 stroke patients

Sampling Method: Simple random sampling.

Study Duration: 4 weeks.

Study setup: The study was conducted in neuro rehabilitation centers.

Participants inclusion Criteria: willing male and females with upper limb spasticity grade 1, 1+ and 2 post strokes.

Exclusion Criteria: Severe cognitive impairment and unstable medical conditions, fixed upper limb deformities.

Material used: mobile phone with metronome app (6.13.0), pen and paper

Outcome measure: Modified Ashworth Scale (MAS), Upper Extremity Functional Index Scale (UEFI).

V. INTERVENTION

The study included 30 stroke patients, divided into two groups by using randomization method each group consisted of 15 subjects. Group A received conventional PNF exercises once in a day for 10 reps 3 days a week for 4 weeks. Group B received PNF exercises synchronized with metronome beats set for 20-25 bpm as per individual tolerance to enhance rhythmic movement and coordination 3 days a week for 4 weeks alternatively. Along with the intervention common exercises including desired protocol were same for both the groups. The groups were divided using randomization method. Spasticity grade and functional assessment was taken at the beginning of the protocol and at the end using Modified Ashworth Scale and Upper Extremity Functional Index Scale (UEFI) respectively.

VI. STATISTICAL ANALYSIS

Data was analyzed using appropriate statistical tests. Pre- and post-intervention values were compared within and between groups. The normality of the distribution of data was assessed by Shapiro-wilk test. Statistical significance was set at $p < 0.05$. To compare the pre and post results of both the groups paired t test was used. Medclac software (version 23.4.0) was used for statistical analysis.

VII. RESULTS

Both groups showed improvement in functional performance. However, the metronome group demonstrated significantly greater improvement. The spasticity grade in both the groups remained unchanged.

VIII. DISCUSSION

The study aimed to check the effectiveness of proprioceptive neuromuscular facilitation combined with metronome beats on upper limb spasticity in stroke patients. Total 30 subjects were included in the study based upon the inclusion criteria, among which 26 subjects were males and 4 subjects were females.

The randomized control trial was designed and the participants were distributed in two groups by using chit method. Each group consisted of 15 participants

The data was normally distributed using Shapiro-wilk test, paired t test was used to compare the pre and post results of both the groups, statistical analysis was done using medclac software. The data indicated that most participants remained at Grade 1, while a small number persisted at Grade 1+ or Grade 2 across sessions. The spasticity grading in both the groups remained constant but there was functional improvement in the experimental group. The consistent spasticity grades can be explained by concept of neuroplasticity. However, this study also explains Rhythmic auditory cues enhance motor timing and neuromuscular coordination. Functional gains were achieved even without significant reduction in spasticity using metronome beats combined with PNF.

IX. CONCLUSION

PNF combined with metronome beats is more effective than PNF alone in improving upper limb functional performance.

X. LIMITATIONS

Small sample size and short duration of intervention.

XI. FUTURE SCOPE

Further research with longer duration, larger samples, and objective outcome measures is recommended.

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