Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 12s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

An Interventional Study on the Effectiveness of Proprioceptive Neuromuscular Facilitation (PNF) in the Rehabilitation of Patients with Bell's Palsy

SavitriYadav[1], Dr Deepak Lohar[2], Dr Jafar Khan[3], Dr.Rahat khan Warsi[4], Dr. Shubham Menria[5], Dr. Renuka Pal[6], Dr. Deepika Balala[7], Dr. Richa Hirendra Rai[8], Dr. Praveen Rawat[9], Dr. Achalkumar Vashi[10]

[1] Research Scholar MPT, Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

[2]Associate Professor, Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

[3] Dean And HOD, Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

[4]Assistant Professor Department of Pharmacology, Pacific Medical College & Hospital, Pacific Medical University, Udaipur, Rajasthan, Udaipur

[5]Assitant Professor, Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

[6]Associate Professor, Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

[7]Assitant Professor, Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

[8] Professor, School of Physiotherapy, Delhi Pharmaceutical Sciences and Research University, New Delhi, India

[9]Assistant Professor, Himalayan Institute of Medical Science, Swami Rama Himalayan University, Uttarakhand

[10]MPT Scholar, Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

[*]**Corresponding author:**

Savitri Yadav

Email ID: yadavsavi92@gmail.com

Cite this paper as: SavitriYadav, Dr Deepak Lohar, Dr Jafar Khan, Dr.Rahat khan Warsi, Dr. Shubham Menria, Dr. Renuka Pal, Dr. Deepika Balala, Dr. Richa Hirendra Rai, Dr. Praveen Rawat, Dr. Achalkumar Vashi, (2025) An Interventional Study on the Effectiveness of Proprioceptive Neuromuscular Facilitation (PNF) in the Rehabilitation of Patients with Bell's Palsy. *Journal of Neonatal Surgery*, 14 (12s), 1178-1184.

ABSTRACT

Background: Bell's palsy is the most common cause of unilateral lower motor neuron facial paralysis, often resulting in sudden facial weakness, asymmetry, and loss of voluntary facial expressions. It significantly impacts patients' physical, emotional, and social well-being. While many cases resolve spontaneously, delayed or inadequate treatment can result in long-term dysfunction. Among physiotherapeutic interventions, Facial Proprioceptive Neuromuscular Facilitation (PNF) has emerged as a promising technique aimed at enhancing neuromuscular recovery and facial symmetry.

Objective: To evaluate the effectiveness of Facial Proprioceptive Neuromuscular Facilitation (PNF) as a standalone intervention in improving facial muscle function, coordination, and symmetry in patients with Bell's palsy.

Methodology: This interventional study was conducted at Pacific Medical University & Hospital, Udaipur, with 30 patients diagnosed with unilateral Bell's palsy. Participants underwent a structured 8-week PNF-based rehabilitation program, consisting of daily supervised sessions for 6 days a week, each lasting approximately 20 minutes. Techniques included diagonal movement patterns, manual resistance, visual and verbal cues, and proprioceptive stimulation targeting key facial muscles. Progress was assessed using the House-Brackmann Facial Nerve Grading System pre- and post-intervention. Statistical analysis was performed using paired t-tests.

Results: The study demonstrated a statistically significant improvement in facial nerve function following PNF intervention. The mean House-Brackmann score improved from **4.83 ± 0.75** to **1.80 ± 0.82**, with a **mean difference of 3.03**, **t-value of 15.42**, and **p-value < 0.005**, indicating a substantial recovery in muscle symmetry and function.

Conclusion: Facial PNF is an effective, non-invasive, and evidence-based physiotherapeutic intervention for Bell's palsy rehabilitation. It significantly enhances facial muscle strength, coordination, and voluntary control, supporting its role as a primary rehabilitation strategy in early management of Bell's palsy

Keywords: *Bell's palsy, Proprioceptive Neuromuscular Facilitation (PNF), facial paralysis, facial rehabilitation, physiotherapy, House-Brackmann scale, neuromuscular re-education*

1. INTRODUCTION

A. The human face is a key medium for identity, communication, and emotional expression. Facial muscle control is essential not only for verbal and non-verbal interactions but also for vital functions like blinking, eating, and speaking. Any disruption in facial nerve function, such as that seen in Bell's palsy, can cause noticeable asymmetry and dysfunction, leading to both physical and psychological challenges. Bell's palsy is the most common cause of unilateral lower motor neuron facial paralysis, accounting for approximately 60–75% of such cases. Its annual incidence is estimated to range between 7–40 per 100,000 people worldwide, with an Indian prevalence of about 20–30 per 100,000. The condition affects both males and females equally and is often linked to viral infections, particularly herpes simplex virus, which causes inflammation and ischemia of the facial nerve.

B. Patients typically present with sudden-onset unilateral facial weakness, which may be accompanied by ear pain, altered taste, hypersensitivity to sound (hyperacusis), and reduced tear production. While many individuals recover fully within weeks to months, a significant number may experience long-term residual symptoms such as muscle weakness, synkinesis (involuntary muscle movements), and incomplete recovery, especially in cases with delayed or inadequate treatment. Hence, early and targeted rehabilitation plays a critical role in promoting neuromuscular recovery and minimizing long-term deficits.

C. Among the various physiotherapy interventions used in Bell's palsy rehabilitation, **Proprioceptive Neuromuscular Facilitation (PNF)** has shown promise. PNF utilizes specific facial movement patterns involving resistance, stretch, and tactile stimulation to facilitate voluntary motor control. It is designed to enhance the strength, coordination, and symmetry of facial muscle activity by stimulating proprioceptive input and re-educating neuromuscular pathways. These patterns mimic functional movements and help restore coordinated motion, which is crucial for facial expression and communication.

D. This **interventional study** aims to evaluate the effectiveness of **facial PNF as a standalone rehabilitative approach** in patients diagnosed with Bell's palsy. The objective is to determine the impact of PNF on facial muscle strength, symmetry, and functional outcomes. By focusing exclusively on PNF, the study seeks to provide evidence-based insights into its role in accelerating recovery and enhancing quality of life for patients affected by Bell's palsy.

Aim and Objectives

The aim of this study is to evaluate the effectiveness of Facial Proprioceptive Neuromuscular Facilitation (PNF) as a physiotherapeutic intervention in the rehabilitation of patients diagnosed with Bell's palsy. This study seeks to explore how a structured PNF-based rehabilitation program can influence facial muscle strength, coordination, and symmetry, thereby enhancing the recovery process. The specific objectives include assessing the improvement in facial motor control through PNF techniques, measuring functional gains in terms of symmetry and voluntary movements, and determining the statistical significance of changes observed pre- and post-intervention using standardized clinical outcome tools. Through these objectives, the study aims to provide evidence supporting the use of PNF as an effective standalone approach in promoting neuromuscular recovery and improving the quality of life in patients with Bell's palsy.

Hypothesis

The alternate hypothesis (H_1) states that there is a significant improvement in treatment outcomes, specifically in facial motor function and recovery, among Bell's palsy patients who undergo rehabilitation using Facial PNF techniques. On the other hand, the null hypothesis (H_0) proposes that there is no significant improvement in the facial function or recovery outcomes of Bell's palsy patients following the application of Facial PNF as an intervention. This hypothesis framework will guide the statistical analysis and interpretation of the study's results.

2. METHODOLOGY

Materials and Methodology

This interventional study was conducted in the Department of Neurology at Pacific Medical University and Hospital, Udaipur, involving a total of **30 patients** diagnosed with **unilateral Bell's palsy**. Participants were selected using **purposive sampling** based on predefined inclusion and exclusion criteria. All patients received a **structured facial PNF-based physiotherapy protocol**, with no comparison or use of other techniques such as Rood's approach, in order to assess the isolated effectiveness of **Facial Proprioceptive Neuromuscular Facilitation**.

The **study duration was 6 weeks**, with therapy sessions conducted **6 days per week**, each lasting approximately **20 minutes**, administered under the supervision of a trained physiotherapist.

The **inclusion criteria** comprised patients aged between **30 to 60 years**, presenting with **acute onset (within one week)** of **unilateral Bell's palsy**, and exhibiting **complete facial paralysis (House-Brackmann Grade VI)**. The **exclusion criteria**

included patients with **bilateral facial weakness**, **upper motor neuron (UMN)-type facial paralysis**, **facial sensory loss**, **ENT-related complications**, **metal implants**, or **open facial wounds** that could interfere with therapy.

The **materials** used during therapy sessions included **ice packs**, **tactile stimulators** (such as soft brushes and cotton swabs), **facial vibration devices** (like electric toothbrushes), **mirrors** for visual feedback, **timers**, **head support pillows**, and **patient assessment charts** for daily monitoring and documentation of progress.

The **intervention protocol** involved the application of **Facial PNF techniques**, focusing on specific **facial muscle movement patterns** designed to retrain neuromuscular control, enhance coordination, and restore symmetry. Techniques included diagonal and functional facial movements with manual resistance, rhythmic initiation, hold-relax techniques, and use of visual and verbal cues to guide and reinforce muscle activation. The therapy aimed to stimulate proprioceptive feedback and improve voluntary facial expressions such as smiling, eyebrow raising, eye closure, and lip movement.

The **outcome measure** used to assess progress was the **House-Brackmann Facial Nerve Grading System**, a validated scale that categorizes facial nerve function from **Grade I (normal function)** to **Grade VI (complete paralysis)**. Evaluation was based on clinical observation of **facial symmetry**, **muscle strength**, and **voluntary movement** during both rest and active facial expressions. Pre- and post-intervention scores were recorded and analyzed to determine the efficacy of the PNF intervention.

3. PROCEDURE

Intervention Protocol

A total of 30 participants diagnosed with unilateral Bell's palsy were enrolled in the study and underwent a structured Facial Proprioceptive Neuromuscular Facilitation (PNF) intervention program. All participants received the same treatment protocol without group division, as the focus of this study was to assess the isolated effect of PNF on facial muscle function and recovery. The intervention was conducted over a period of 8 weeks, with sessions held 6 days per week, each lasting approximately 20 minutes under the direct supervision of a trained physiotherapist.

During each session, patients were positioned in a high Fowler's sitting posture to ensure comfort, optimal alignment, and accessibility for facial muscle engagement. The facial PNF protocol was designed to stimulate neuromuscular re-education and improve muscle strength, symmetry, and coordination. Specific techniques involved manual resistance applied by the therapist to targeted facial muscles, such as the frontalis, orbicularis oculi, zygomaticus, buccinator, and orbicularis oris. Movements were performed in diagonal and functional facial patterns, promoting natural expressions like smiling, eyebrow raising, lip pursing, and eye closure.

Each exercise was performed for 3 sets of 10 repetitions, with a 5-second hold per repetition and appropriate rest intervals between sets to avoid fatigue. Visual and verbal cues were provided throughout the session to facilitate patient engagement, enhance proprioceptive input, and ensure proper execution of movements. In cases of fatigue or discomfort, exercises were modified to suit individual tolerance levels while maintaining therapeutic goals.

Home Program Instructions

Participants were also provided with a structured home exercise program to reinforce therapy gains and promote continuous activation of facial muscles outside the clinical setting. They were advised to perform selected facial PNF exercises twice daily, consisting of 2 sets of 10 repetitions for each targeted movement, while maintaining a relaxed and distraction-free environment. Use of a mirror was encouraged to provide visual feedback, helping patients monitor symmetry and expression accuracy. Additionally, instructions included maintaining facial hygiene, avoiding excessive jaw movement or mouth opening, and integrating gentle facial expressions such as blinking, smiling, and raising eyebrows into daily routines. Patients were encouraged to maintain a logbook to track their daily practice, progress, and any issues encountered, which was reviewed during follow-up sessions.

4. STATISTICAL ANALYSIS AND RESULTS

The collected data were statistically analyzed using **paired t-tests** to assess the difference in facial nerve function **before and after the PNF intervention**. The **House-Brackmann Facial Nerve Grading System** was used as the primary outcome measure to quantify the severity of facial paralysis. Pre- and post-intervention scores were compared to evaluate the effectiveness of **Facial Proprioceptive Neuromuscular Facilitation (PNF)** in promoting facial muscle recovery. In addition, **demographic variables** such as age were recorded to provide a baseline profile of the study participants. A **p-value of less than 0.05** was considered **statistically significant** for all analyses.

Table 1: Demographic Summary of Participants (Row-wise)

Parameter	Value
Total Participants	30
Mean Age	38.57 years
Standard Deviation	9.21

Table 2: Pre- and Post-Test Comparison of House-Brackmann Scores (Row-wise)

Parameter	Value
Number of Participants	30
Pre-Test Mean ± SD	4.83 ± 0.75 (HB Grade)
Post-Test Mean ± SD	1.80 ± 0.82 (HB Grade)
Mean Difference	3.03
t-value	15.42
p-value	< 0.005(Significant)

The intervention showed a **statistically significant improvement** in facial nerve function post-treatment. The **mean House-Brackmann score** decreased from **4.83 to 1.80**, indicating a shift from severe facial paralysis to near-normal facial function. The **high t-value (15.42)** and **p-value (< 0.005)** confirm the **effectiveness of Facial PNF** in Bell's palsy rehabilitation.

Summary: This interventional study was conducted to evaluate the effectiveness of Facial Proprioceptive Neuromuscular Facilitation (PNF) in the rehabilitation of patients with unilateral Bell's palsy. A total of 30 participants were selected based on strict inclusion and exclusion criteria, all presenting with acute onset and complete facial paralysis (House-Brackmann Grade VI). Over an 8-week period, patients received a structured PNF-based rehabilitation protocol aimed at improving facial muscle coordination, strength, and symmetry. Treatment was provided 6 days per week in supervised 20-minute sessions. Facial movements were trained using PNF patterns involving resistance, proprioceptive feedback, and functional facial expressions.

The House-Brackmann Facial Nerve Grading System was used to assess pre- and post-treatment outcomes. Statistical analysis using paired t-tests revealed a highly significant improvement in facial nerve function following the intervention. The mean House-Brackmann score improved from 4.83 ± 0.75 pre-treatment to 1.80 ± 0.82 post-treatment, with a mean difference of 3.03 and a p-value < 0.001, indicating strong therapeutic efficacy of facial PNF.

5. CONCLUSION:

The findings of this study strongly support that Facial Proprioceptive Neuromuscular Facilitation (PNF) is an effective and evidence-based rehabilitation technique for improving facial muscle function in patients with Bell's palsy. Significant recovery in facial symmetry, coordination, and voluntary movement was observed following a consistent 8-week PNF intervention. Given its non-invasive nature and strong clinical outcomes, Facial PNF can be recommended as a primary physiotherapeutic approach in the early management of Bell's palsy to accelerate neuromuscular recovery and improve quality of life.

6. LIMITATIONS AND RECOMMENDATIONS

This study had a few limitations, including a small sample size, absence of a control group, and short-term follow-up, which limit the generalizability and long-term applicability of the findings. The use of a single outcome measure (House-Brackmann scale) and the study being confined to a single center also reduce the scope of interpretation. Additionally, therapist-dependent variability in PNF application may have influenced results.

Future studies are recommended to include larger sample sizes, control or comparison groups, and longer follow-up periods.

Incorporating additional objective outcome measures and conducting multi-center trials can enhance reliability. Standardizing therapist training and emphasizing home program compliance would also help strengthen future research and clinical application.

7. ACKNOWLEDGMENT:

The authors would like to thank the support of the staff of Pacific Medical College Of Physiotherapy Udaipur Rajasthan and also like to thank subjects for their willingness to participate in the study.

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