

# PNF Training for Improving Lower Limb Coordination in Cerebral Palsy: A Case Study in a Child with Spastic Diplegia

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## ABSTRACT

The research focused on assessing the effectiveness of PNF training on lower limb coordination on a Male child with spastic diplegia Cerebral Palsy. Mental and physical dysfunctioning along with the growth, sensation and gait disturbances is termed as Cerebral Palsy. This is unconditional neurological problem that has severe effect on the control and coordination of muscles. This generally occurs at early childhood age or infancy. This research is a case study in which subject was a child with dysfunctioning arms and legs. The branch of Cerebral Palsy that deals with dysfunctioning of arms and legs is termed as Spastic Diplegia. The patient underwent PNF on both lower limbs (hip, knee, foot), followed by hot fermentation. After the intervention, significant improvement is seen in all the outcome measures (gait parameter, BBS score, GFMC score) .As the result affected lower limb improved in terms of coordination, execution and accurateness of the movement, number of jerks, and duration of clonus. Improvement was seen in preciseness and accurateness of coordinated movement at the different ranges of motion for lower limbs. PNF seems to be a promising intervention for improving lower limb movement coordination in Cerebral palsy children. Further investigations are certainly needed to assess.

**Keywords:** Cerebral palsy, Proprioceptive Neuromuscular Facilitation, Gait Training, Balance, Incoordination.

## 1. INTRODUCTION

Cerebral Palsy is considered to be the mundane disability that is chronic. This is the disability most common in today's

childhood[1]. Cerebral palsy is considered as severe mental, physical dysfunction along with disturbances in growth, gait, cognition and sensation[2]. Commonest childhood disability hampering physical growth the most, worldwide affecting 2 to 2.5 children per 1,000 live born [3]. Spastic Diplegia (both legs are affected) is predominant type of CP preterm infants specially born with birth weights below 1000gm [4].

Velocity dependant increased in resistance to passive muscle stretch is considered as Spasticity [5] .The onset of spasticity in the legs is during the first year. During first 4 months of life most of spastic diplegic children have normal tone, or hypotonia. In first year onset of spasticity is insidious and slowly progressive [6].

Lesion in sensorimotor cortex and extra pyramidal system (corticospinal tract) results in lower limb dysfunction. The lower limb is usually more severely involved than upper limb. This restricts walking, ascending and descending stairs, exploration, play and other ADL activities [7].

Common management effective in spastic diplegia includes pharmacological (botulinum toxin, intrathecal pump and surgical management (orthopaedic surgery), constraint induced movement therapy, occupational therapy, Neuro-Developmental Therapy, Sensorimotor training program, balance training, Proprioceptive Neuromuscular Facilitation and other traditional physiotherapy techniques to

improve gait, balance and coordination of lower limb function [1],[8].

PNF is considered as very effective therapeutic exercise for the betterment of gait and dynamic balance [9]. PNF is used widely in clinics to treat post stroke physical dysfunctions[10]. Studies done states that PNF techniques mainly focus on muscle activity. Evidences also suggest change in stiffness and increased tone due to spasticity after stroke [12].

Most of the literature work done earlier focussed on using of PNF for the management of Stroke patient to reduce spasticity and improve tone. This case study aim to use PNF as an potential approach to show improvement in gait parameter, walking status, balance and functional independence.

## 2. Patient Information

Patient was 7 year old Spastic diplegic male child who was under physiotherapy treatment since past 2 years which includes PROM of all the joints, Mat and gym ball exercises. Child was having good communication skills, but not going to school. Able to perform his ADLs activities with difficulty, highest functional ability was independent sitting, donning on & off clothes with assistance. His primary concern was his difficulty of independent standing, walking and inability to go up and down stairs. He was taking muscle relaxants earlier on regular basis, but currently not taking any medication and no psychological illness found. Patient was already diagnosed by paediatrician as Spastic cerebral palsy.

## 3. Diagnostic Assessment

Balance was assessed by Berg balance scale; different parameters like (Stride length (cm), Cadence (steps/min) and Gait velocity (m/ min)) were used to evaluate gait characteristics. Gross Motor Function Scale is used to check independence level of the child. Pre and post scores of all the variables are shown in Table no 2.

## 4. Clinical Findings

The important clinical findings were showed in Table no 1. Limited dorsiflexion was seen in bilateral feet. In postural examination bilateral flat foot, exaggerated lumbar lordosis, bilateral adductor tightness, valgum deformity is seen at knee. It was seen in the assessment that patient was able to perform with bilateral upper limb without much difficulty.

Table 1: Patients parameters diagnosed during assessment

		Left	Right
MUSCLE TONE	Hip Adductors	1+	1+
	Hamstrings	2+	1+
	Calf Muscles	1+	1+
REFLEXES	Knee Reflex	+++	++
	Ankle Reflex	+++	+++

## 5. Therapeutic Intervention

In starting of the treatment session to normalize increased tone inhibitory techniques were given. It took 3 months to normalize tone. Session was started with rhythmic stabilization exercises of entire lower limb focusing on proximal joint primarily to gain stability of lower limb. After that sets of hold relax and dynamic reversals in both the diagonal pattern performed, initially with assistance later on without assistance. Exercises were performed in both supine and standing positions. Treatment was given 40 minutes a day, for 6 days a week for 16 weeks. Follow up was taken after each 15 days to see the long term effect of treatment.

Table 2: Pre and post scores of outcome measures

	Pre Scores	Post Scores
Berg Balance Scale Score	18	30
Stride length (in cm )	60	75
Step length (in cm )	35	48
Cadence (in cm )	38	48
GMFCS score	Level V	Level IV

Outcome measures were recorded before and after completing treatment that is 1 day of the treatment and after 16 weeks. Treatment protocol was not changed and only dosage was progressed. Treatment was not even missed for a single day. After 4 months during follow up it was found that treatment was effective. Activity specific lower limb training, Sit to Stand, Single leg standing like activities , muscle stretching exercises was given to the patient to

perform at home as the part of Home Exercise Program.

## 6. DISCUSSION

Present study aimed to evaluate the efficiency of PNF training in improving lower limb coordination in a child with Spastic diplegic Cerebral palsy. Evidences are present in previously done studies of PNF in stroke populations were proved to be highly beneficial. Sang Wang et al in their study applied PNF to chronic stroke patients and concluded that it decreases muscle stiffness and abnormally increased muscle tone. FCR muscle of affected side with MAS grade 2 in stroke patients with Brunnstrom stage III showed significantly lower muscle tension and stiffness after PNF intervention [11].

Furthermore, another study suggests that combined PNF patterns are effective in treating increasing the muscle activity of the rectus femoris, vastus medialis, tibialis anterior, lateral hamstring, and lateral gastrocnemius after stroke. It was reported in a study that stroke patients at Brunnstrom stages II or III showed decreased muscle tone on the affected side after the PNF intervention.

Another study done Kumar et al in 2016 which states both PNF and task oriented therapy on lower extremity function shown better results in CP children. The study focuses on PNF interventions for improving coordination. Also another objective of study was to make ADL activities possible with ease in children. Significant improvement is seen in Berg balance score when compared pre and post treatment, all this is because the amount of motor learning and control happens in children is very fast in initial age. Significant improved was seen in gait parameters as child started walking with support, 2 steps of stair (up and down) in one go. It was concluded that the treatment is effective and helping him to progress day by day. Though till now we have not achieved independent walking completely, although the achievements we have got in

this child motivated us to follow the similar protocol in other children too.

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