A Study to Evaluate the Effect of Proprioceptive Neuromuscular Facilitation Stretching on Balance and Gait in Spastic Diplegic Cerebral Palsy: An Interventional Study

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Abstract

Background: Cerebral Palsy is a static, non-progressive disorder that results from brain insult or injury during any of the prenatal, perinatal and postnatal stages. Proprioceptive neuromuscular facilitation integration pattern stimulates the proprioceptors with in the muscle and tendon to enhance the performance, flexibility and balance. It is generally effective in maintaining the reaction of exercise unit by increasing the co-ordination which react to the stimulation in muscular strength and flexibility. **AIM:** To evaluate the effect of Proprioceptive neuromuscular facilitation Stretching on balance and gait in spastic diplegic cerebral palsy.

Method: Total 30 Spastic diplegic cerebral palsy subjects were assessed as per Selection criteria of the study. Consent form taken from children's parents. They were randomly divided into group-A (n=15) and group-B (n=15). spastic diplegic cerebral palsy were assessed for baseline outcome measures Pediatric berg balance, WeeFIM scale ,10 Meter walk test on day 1 and after 4 week.

Group-A was given conventional treatment and Propioceptive neuromuscular facilitation stretching which include hold -relax and contract- relax for 6-second hold and 10 repetitions for 5 days/week for 4 weeks.

Group-B was given conventional treatment. Statistical analysis was done using SPSS Software.

Conclusion: Neuromuscular facilitation stretching along with conventional therapy is more effective to improve the balance and gait in spastic diplegic cerebral palsy.

Keywords: *spastic diplegic cerebral palsy. Proprioceptive neuromuscular facilitation technique, Gait, Balance*

Introduction

"Cerebral" refers to the brain, and "Palsy" refers to muscle weakness/poor control. Cerebral palsy (CP) is a term used to describe a problem with posture and movement that makes certain activities difficult. Someone who has cerebral palsy has problems moving his or her muscles; this is not because of muscles or nerves, these difficulties are caused because of problems in the brain.[1] Cerebral palsy is a well-recognized neurodevelopment condition beginning in early childhood and persisting through the lifespan.[2]

These disorders are attributed to nonprogressive disturbances that occurred in the developing infant brain or fetal. The motor disorders of CP are often accompanied by disturbances of perception, sensation, cognition, communication, and behavior, by epilepsy and by secondary musculoskeletal problems.[3]

The spastic CP type is described by exaggerated deep tendon reflexes, increased muscle tone, muscle weakness, and gait affection. Nearly 70–77% of CP

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cases were spastic CP.[4] Spastic diplegia (SD) is a motor impairment in the upper extremities as well as the lower extremities. The constrained capacity to generate force result in activity limitation more than the spasticity did.[6]

In spastic diplegic children, abnormal gait patterns can result from disturbance of balance, muscle weakness, spasticity and skeletal deformities.[7,8]

These patterns are characterized by lack of mobility in the lumbar spine, pelvis and hip joints and show asymmetric pelvic motion during walking. A lot of the ambulatory children with spastic diplegia were able to attain a walk in the form of a crouch gait with flexed hips, knees and ankles.[9]

The overall pooled prevalence of cerebral palsy per 1000 children surveyed was 2.95 (95% CI 2.03–3.88). Sub-group analysis for rural, urban and mixed rural-urban study population demonstrated the pooled prevalence as 1.83 (95% CI 0.41–3.25), 2.29 (95% CI 1.43–3.16) and 4.37 (95% CI 2.24–6.51) respectively.[10]

Proprioceptive neuromuscular facilitation integration pattern stimulates the proprioceptors with in the muscle and tendon to enhance the performance, flexibility and balance. It is generally effective in maintaining the reaction of exercise unit by increasing the co-ordination which react to the stimulation in muscular strength and flexibility.

The facilitated progression due to PNF procedures follows a hierarchical process from mobility to stability then controlled mobility to skillful movement. Studies have stated that PNF stretching is effective in improving muscle strength, flexibility, posture coordination and gait.

Method

- **Study Design:** interventional Study
- **Study Setting:** Morbi City
- **Sampling Technique:** Purposive Sampling
- **Study Population:** Spastic diplegic cerebral palsy
- **Sample Size:** 30 Subjects
- **Study Duration**: 6 months

Selection Criteria:

Inclusion Criteria:

- Children diagnosed as Spastic Diplegic cerebral palsy.
- Age bsetween 5-12 years and both gender.
- Gross motor function level I and II.
- Written consent from their parents.
- Spasticity range between 1 and 1+ grade according Modified Ashworth scale.
- Able to follow simple verbal instructions.

Exclusion Criteria:

- Uncooperative subjects.
- Uncontrolled epilepsy.
- Receiving botulinum toxin injections or surgery no earlier than 6 months before project start.
- Presence of shortening or deformities of the ankle, knee and/or hip joints that prevented the children from keeping their feet on the ground.

Procedure:

The proposal is approved by Ethical clearance for the study was obtained from the Ethics Committee, School of Physiotherapy, RK University and CTRI (Clinical trial registry – India).

Written consent was taken from subjects' parents who fulfilled selection criteria and were willing to participate in the study.

On the first visit, spastic diplegic cerebral palsy was assessed for baseline outcome measure WeeFIM, Pediatric berg balance and 10 meter walk test.

Group A (n=15): conventional Physiotherapy and Proprioceptive neuromuscular facilitation stretching which include hold -relax and contract- relax for 6-second hold and 10 repetitions and 2 minutes rest in between, for 5 days/week for 4 weeks.

Group B (n=15): conventional Physiotherapy.

Result

Data Analysis:

Descriptive statistics were used to describe sample characteristics. The significance level selected was 0.05.

Statistical Analysis:

All the statistical analysis was done by statistical package for the social science (SPSS) Statistical software version 21.0 for windows. The pre and post value were collected from both the group before and after intervention. Statistics was performed by using the following statistical tests:

For, Pediatric Balance Scale and WeeFIM:

Intra Group: Wilcoxon signed-rank Test

Inter Group: Mann-Whitney U Test

For, 10MWT:

Intra Group: Paired T Test

Inter Group: Un-paired T Test

TABLE 1: GROUP A INTRAGROUP ANALYSIS

OUTCOME	MEAN		SD		T/Z Value	P Value
	Pre	Post	Pre	Post		
PBS	29.80	32.20	1.69	1.82	Z Value=3.456	0.001
WeeFIM	77.46	79.20	2.89	3.028	Z Value=3.341	0.001
10MWT	0.498	0.433	0.0013	0.015	T Value=5.727	0.000

The mean average for PBS improved from 29.80(pre) to 32.20(post). Similarly, for WeeFIM the mean average improved from 77.46(pre) to 79.20(post) and for 10MWT mean average improved from 0.498(pre) to 0.433(post). As per data reflects that P value is lesser than 0.05 which shows significant difference in PBS, WeeFIM and 10MWT IN Group A.

TABLE 2: GROUP B INTER GROUP ANALYSIS

OUTCOME	MEAN		SD		T/Z Value	P Value
	Pre	Post	Pre	Post		
PBS	30.53	30.60	2.29	2.38	Z Value=0.332	0.739
WeeFIM	80.40	80.20	1.88	1.52	Z Value=0.690	0.590
10MWT	0.049	0.059	0.049	0.052	T Value=0.332	0.924

The mean average for PBS from 30.53(pre) to 30.60(post) was not significantly improved. Similarly, for WeeFIM the mean average was not improved from 80.40(pre) to 80.20(post) and for 10MWT mean average from 0.049(pre) to 0.059(post) was not significantly improved. As per data reflects that P value is more than 0.05 which shows significantly not improved in PBS, WeeFIM and 10MWT.

TABLE 3: INTRA GROUP ANALYSIS

OUTCOME	MEAN		SD		Z Value	P Value
	Group A	Group B	Group A	Group B		
PBS	4.66	0.66	1.496	0.798	4.546	0.000
WeeFIM	5.26	0.200	2.016	1.146	3.3451	0.000
10MWT	0.052	0.050	0.0065	0.0045	4.253	0.001

The mean average for PBS is 4.66(post) and 0.66(post) respectively for group A and B. similarly for WeeFIM the mean 5.26(post) and 0.200(post) for group A and B. and the mean average for 10MWT is 0.52(post) and 0.050(post) respectively for group A and B. As per data reflects that P value is lesser than 0.05 which shows significant difference between both groups.

Discussion

The results of the present study showed that conventional physical therapy and Propioceptive neuromuscular facilitation stretching is more effective to improve Gait, Balance and Functional independence in spastic diplegic cerebral palsy. Thus, the null hypothesis is rejected.

The probable mechanism by which PNF could have worked is by facilitating the neuromuscular mechanism, by stimulating the proprioceptors.

PNF increases the ROM by increasing the length of muscle and the neuromuscular efficiency. The physiological mechanism for increasing the ROM and strength may be due to autogenic inhibition, reciprocal inhibition, and stress relaxation so, it helps to lengthening the contracted structures, relax the hypertonic muscles, initiating the movements, strengthening the weak muscles and improving the control of the pelvis.

The reason for better balance and lower extremity function in PNF group may be due to the way it utilizes the different proprioceptive information for stimulating nerve and muscles function by utilizing distinct helical form pattern which is based on functional components to aid reaction of motor system located in muscles and joints, and turn human movements into patterns for various uses such as exercise intervention. Improvement of balance ability might have resulted from facilitation of proprioceptive sense, leading to change in various supports leads to increase in stability of joints.

PNF have various exercises aim to improve stability and mobility components, once the desired stability components are achieved it mobility component further helps to improve function.

Logeshwari Selvaraj [2018] conducted study in which Proprioceptive Neuromuscular facilitation technique on trunk were Trunk exercise and PNF techniques was perfume on spastic hemiplegic cerebral palsy and concluded that the PNF technique exercises improved significantly better performance in their activities of daily living.

Chandan Kumar [2016] conducted study on Comparison between Task - Oriented Training and Proprioceptive Neuromuscular Facilitation Exercises on Lower Extremity Function in Cerebral Palsy. Concluded that both Task-Oriented Approach and Proprioceptive Neuromuscular Facilitation Exercises are beneficial in improving lower extremity function in children with cerebral palsy.

Further recommendation:

- Study can be done with other type of PNF technique
- Study can be done on other type of cerebral palsy or on other type of neurological conditions like stroke.

Conclusion

This study concluded that proprioceptive neuromuscular facilitation stretching along with conventional therapy is more effective to improve the balance and gait in spastic diplegic cerebral palsy patients.

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Conflict of Interest: Nil

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Ethical Clearance: Ethics committee, RK university.

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