COMPARING THE IMPACT OF VIBRATION THERAPY AND PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUE ON SPASTICITY REDUCTION AND ENHANCEMENT OF LOWER EXTREMITY FUNCTION IN CHILDREN WITH CEREBRAL PALSY.

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ABSTRACT

Cerebral palsy is a non-progressive condition that primarily affects children before, during, and after birth. The objective of this study was to determine the comparative effectiveness of whole body vibration and the proprioceptive neuromuscular facilitation (PNF) technique in reducing spasticity and improving lower extremity function in children with cerebral palsy. A pre- and post-study design was employed, and 24 subjects with spasticity and weakness in the lower extremities were randomly assigned to two groups. Group A received whole body vibration in conjunction with conventional therapy, while Group B received the proprioceptive neuromuscular facilitation technique known as Hold relax Contract relax, also combined with conventional therapy. The total treatment period lasted for 6 weeks. Significantly greater improvements were observed in Group A, the whole body vibration group, in terms of spasticity (mean difference = MMAS LL = 2.33 and MMAS RL = 2.25) and lower extremity function (mean difference = 31.67), compared to Group B, the proprioceptive neuromuscular facilitation group, in terms of spasticity (mean difference = MMAS LL = 2.91 and MMAS RL = 2.91) and lower extremity function (mean difference = 21.41). Therefore, it can be concluded that whole body vibration is the most effective approach for reducing spasticity and improving lower extremity function in children with cerebral palsy.

Keywords: FIM – Functional Independence Measurement, MAS – Modified Ashworth Scale, MMAS – Modified Modified Ashworth Scale, MTS – Modified Tardieu Scale

INTRODUCTION

Cerebral Palsy, also known as "Little Disease" in reference to the orthopedic surgeon "Little Club," encompasses two key aspects. "Cerebral" pertains to the brain, while "Palsy" signifies weakness. Diagnosis of CP typically occurs around the age of 2, with medical history and physical examination revealing progressive motor impairments. The incidence rate stands at 2.1 per 1000 live births, but rises to 40-100 per live births for babies with permanent or very low birth weights. CP is classified based on neurological symptoms into Spastic, Dyskinetic, and Ataxic types. Risk factors include prematurity, perinatal intrauterine growth, and acidosis, which can lead to brain injury.

Whole Body Vibration Training comprises two components: Frequency measured in hertz and Amplitude measured in millimeters. Research by Huang et al., (2017) suggests that Whole Body Vibration shows promise in clinical rehabilitation for children with CP, as it can help control spasticity and enhance ambulatory performance, ultimately increasing the active Range of Motion. In a study conducted by Huang et al., (2017), a 20-minute session of whole body vibration was administered to 16 participants aged 2 years on separate days, resulting in significant differences in the Modified Ashworth Scale scores.

Another study by Lee et al., (2019) concluded that whole body vibration (WBV) could be a beneficial intervention to improve muscle strength in the lower extremities of children with spastic cerebral palsy. In this study, 20 children with spastic CP were randomly assigned to two groups. The experimental group consisting of 10 children received WBV therapy along with five general physiotherapy sessions, while the control group of 10 children only received general physiotherapy sessions. The total treatment period lasted for 10 weeks, during which muscle thickness and gross motor function (GMF) were measured. Significant improvements were observed in the experimental group.

In summary, Cerebral Palsy, often referred to as "Little Disease," encompasses weaknesses associated with the brain. Diagnosis occurs around the age of 2 through medical evaluation, revealing progressive motor impairments. Whole Body Vibration Training has shown potential for reducing spasticity and improving ambulatory performance in children with CP, as demonstrated by various studies. This intervention may enhance muscle strength and gross motor function in the lower extremities of children with spastic CP.

Proprioceptive Neuromuscular Facilitation (PNF) is a flexibility training technique that effectively reduces hypertonicity and promotes muscle relaxation and strength (Victoria, G.D. et al., 2013). PNF involves various concepts to stimulate proprioceptors for facilitation, and it has been observed to play a crucial role in reducing spasticity (Alashram, A.R. et al., 2021). One specific technique within PNF is the Hold Relax technique, which involves lengthening the muscles to a specific point where an individual performs an isometric contraction for 10 seconds, followed by passive limb movement to a new range of motion (Puentedura, E.J. et al., 2011).

In a study conducted by Dabhi et al., (2020), it was concluded that the neuromuscular facilitation technique, in combination with conventional therapy, was more effective in improving balance and gait in children with spastic diplegic cerebral palsy. The study included 30 subjects with spastic CP, divided into two groups. One group of 15 subjects received conventional therapy along with the Proprioceptive Neuromuscular Facilitation (PNF) Hold-Relax Contract-Relax technique, involving a 6-second hold and 10 repetitions, five days a week for a total of four weeks. The other group of 15 subjects received only conventional therapy for the same duration and number of sessions.

In summary, PNF is a technique used in flexibility training that effectively reduces hypertonicity and promotes muscle relaxation and strength. Within PNF, the Hold Relax technique plays a significant role in reducing spasticity. Dabhi et al., (2020) conducted a study on children with spastic diplegic cerebral palsy and found that combining the neuromuscular facilitation technique with conventional therapy resulted in greater improvements in balance and gait compared to conventional therapy alone.

MATERIALS AND METHODS

A Pre-Test and Post-Test Experimental Study Design was employed for this research. The study focused on children with cerebral palsy who exhibited spasticity, including both males and females. The sample size consisted of 24 subjects, who were randomly assigned to two groups: Group A received Whole Body Vibration, while Group B received the Proprioceptive Neuromuscular Facilitation (PNF) technique.

The inclusion criteria for the study were children with cerebral palsy, aged 2 to 14 years, and presenting spasticity in the lower extremities. Exclusion criteria included children with flaccid paralysis, any other neurological conditions, recent surgeries, and those undergoing treatment with botulinum toxin or other medications.

In the field of clinical practice and research, the most commonly used tool for measuring spasticity is the Asworth Scale. However, recent challenges have emerged regarding its reliability and validity. In an effort to improve the scale, Ansari et al., introduced a modified version known as the Modified Modified Asworth Scale (MMAS). This revised scale eliminates the "1+" grade and refines the "2" grade, resulting in a scoring range of 0 to 4 on this ordinal scale. Ghobi et al., conducted a study to assess the interrater reliability of the MMAS, involving 22 adults with lower limb spasticity resulting from stroke and multiple sclerosis. The results demonstrated effective interrater reliability for lower limb assessment (Ghotbi, N. et al., 2011).

SCORE	DEFINITION
0	No increase in skeletal muscle tone.
1	Slight increase in skeletal muscle tone manifested by catch and release at end of range of motion.

2	Slight increase in skeletal muscle tone, manifested by catch, followed by minimal resistance throughout range of motion.
3	Considerable increase in skeletal muscle tone.
4	More marked increase in skeletal muscle tone throughout range of motion.
5	Rigid in flexion or extension.

The Pediatric Balance Scale, derived from the Berg Balance Scale, is a modified version used to evaluate functional balanced mobility in children. This scale consists of 14 items, each scored on a scale of 0 to 4 points, with a maximum total score of 56 points, where higher scores indicate better function. A reliability test was conducted on a group of 20 children aged 4 to 15 years with mild to moderate impairments. The results demonstrated good test-retest reliability and interrater reliability, indicating the scale's consistency (Ghotbi, N. et al., 2011). The Pediatric Balance Scale is primarily utilized with school-aged children who have mild to moderate motor impairments.

Furthermore, a validity test was performed on the scale to assess its accuracy. This test involved children aged 3 to 10 years with spastic cerebral palsy, and the results indicated good validity of the Pediatric Balance Scale (Franjoine, MR. et al., 2003).

Item Descriptions

- Sitting to standing
- Standing to sitting
- Transfers
- Standing unsupported
- Sitting unsupported
- Standing with eyes closed
- Standing with feet together
- Standing with one foot in front
- Standing on one foot
- Turning 360 degrees
- Turning to look behind
- Retrieving object from floor
- Placing alternate foot on stool
- Reaching forward with outstretched arm

PROCEDURE

The study included 24 children with cerebral palsy who exhibited spasticity and lower extremity functional limitations, meeting the specified inclusion criteria. To assess spasticity, the Modified Modified Asworth Scale was used, while the Pediatric Balance Scale was employed to evaluate lower extremity function. Each child's guardian received a comprehensive session that explained

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the purpose, risks, and benefits of the study. Only those who voluntarily agreed to participate were enrolled, and their guardians were provided with a consent form to sign.

Demographic and health-related information, such as the child's age, gender, and cause of cerebral palsy, was collected from each guardian. Once the consent forms were signed, the procedure commenced. Both groups received weight-bearing exercises as conventional therapy.

In Group A, consisting of 12 children, the treatment protocol involved administering conventional therapy followed by whole body vibration. The children were first given the conventional therapy session, after which they were positioned on the whole body vibration plate. The vibration was applied at a frequency of 20 Hz, with a plate speed set at 60. Each session lasted for 15 minutes. The total treatment regimen consisted of four sessions per week, continuing for a period of six weeks.

Group B- 12 children of this group were given conventional therapy followed by Proprioceptive Neuromuscular facilitation hold relax contract relax technique. After that, conventional therapy was given followed by the Proprioceptive Neuromuscular facilitation of hold relax contract relax technique. Hold relax and contract relax was given with 4 second hold with 2 second contract position with total 10 repetitions and there was 3 minutes rest in between. The technique was given in lower extremities. The session continued for 15 minutes. The total session continued for 4 days/week for 6 weeks.

RESULTS

Data was taken from a total of 24 participants (Group A (WBV) group = 12, Group B (PNF) group = 12). There was a significant difference in outcome variables in each group ($p \leq 0.05$). Tables defines the details of demographic data of between group result:

Variables	M ± SD	MD	t – test	P – value
Group A	2.75 ± 0.53	2.75	10.34	0.002
Group B	3.15 ± 0.28	3.14	22.15	0.000

TABLE 1: t – test present mean difference b/w groups (MMAS)

After final calculation of Between group data, researcher found that significant effect occur in Group A(Whole Body Vibration Group) with MD – 2.75 in comparison to Proprioceptive Neuromuscular Facilitation Group MD – 3.14 .i.e Whole Body Vibration provide more effect in reducing spasticity in MMAS Scoring.

Variables	M ± SD	MD	t – test	P – value
Group A	3.79 ± 6.74	3.78	3.076	0.005
Group B	2.63 ± 4.69	2.63	3.071	0.005

TABLE 2: t – test present mean difference b/w groups (PBS)

After final calculation of Between group data, researcher found that significant effect occur in Group A (Whole Body Vibration Group) with MD – 3.78 in comparison to Group B Proprioceptive Neuromuscular Facilitation Group MD – 2.63 .i.e Whole Body Vibration provide more effect in improving lower extremity function in PBS Scoring

DISCUSSION

After 6 weeks of intervention, both groups exhibited a significant reduction in spasticity and improvement in lower extremity function in children with cerebral palsy, as assessed by the Modified Modified Asworth Scale (MMAS) for spasticity and the Pediatric Balance Scale (PBS) for lower extremity improvement.

Whole Body Vibration (WBV) utilizes mechanical stimulus in the form of oscillatory motion. The intensity of WBV is determined by biomechanical variables such as amplitude and frequency. Amplitude refers to the extent of oscillatory motion, while frequency represents the cycle of oscillation or repetition rate, measured in hertz (Hz) (Cardinale et al., 2005). WBV has demonstrated positive effects on neuromuscular performance and balance in healthy individuals, as well as strength and balance in patients with neurological and musculoskeletal conditions (Saquetto et al., 2015; Rauch, 2009).

Proprioceptive Neuromuscular Facilitation (PNF) is a technique that incorporates flexibility training to reduce hypertonicity, promoting muscle relaxation and strengthening (Victoria et al., 2013). PNF has also shown significant efficacy in reducing spasticity (Alashram et al., 2021).

Baseline analysis of Groups A and B revealed significant differences in baseline characteristics, indicating that the subjects in both groups were not initially matched. However, when comparing the pre- and post-intervention levels of both groups, a significant improvement was observed in MMAS and PBS scores in Group A, indicating that Whole Body Vibration was more effective in reducing spasticity and improving lower extremity function compared to the Proprioceptive Neuromuscular Facilitation group in children with cerebral palsy. The study results showed a significant effect in Group A, with a mean difference of 2.33 in MMAS LL compared to Group B's mean difference of 2.91 in MMAS LL, and a mean difference of 2.25 in MMAS RL compared to Group B's mean difference of 2.91 in MMAS RL. Additionally, there was a significant effect in

Group A for PBS, with a mean difference of 31.67 compared to Group B's mean difference of 21.41.

Based on the acquired data, it has been observed that Whole Body Vibration (WBV), specifically Group A, had a greater impact on reducing spasticity and improving lower extremity functions in children with cerebral palsy. Our study aligns with the findings of Hsin-Yi Kathy Cheng et al.'s study, "Effects of whole body vibration on spasticity and lower extremity function in children with cerebral palsy," and similar research that reported significant improvements in spasticity control and ambulatory performance through repeated measures analyses of WBV. Huang M et al. also concluded that WBV has the potential to control spasticity and enhance ambulatory performance, leading to increased active range of motion. In their study, a 20-minute WBV session was conducted with 16 participants aged 2 years, and significant differences were observed in the Modified Asworth Scale scores (Huang, M. et al., 2017).

Our study is also consistent with Ujwal Lakshman Yeole et al.'s study, "Effectiveness of Proprioceptive Neuromuscular Facilitation on Spasticity in Hemiplegia: Randomised Controlled Trial," and similar research that demonstrated the significant effectiveness of PNF technique over conventional physiotherapy in reducing spasticity and improving functional activities in hemiplegia. Shanmugam et al., conducted a study with cerebral palsy children who had impaired trunk control and concluded that the application of PNF technique in combination with conventional therapy contributes to improved trunk control and reduced disability or impairment in spastic diplegic cerebral palsy children. The study included 36 children with diplegia aged 8-15 years, divided into an interventional group and a control group. The interventional group received pelvic PNF along with conventional therapy, while the control group received only conventional therapy. The total session duration was 4 weeks (Shanmugam, S et al., 2020).

Some studies, such as the one conducted by Rajalaxmi et al., yielded results that were not contrary to our findings. Their study compared task-oriented training and PNF technique, and it showed that task-oriented training yielded more significant results than PNF technique. The study involved 20 subjects divided into two groups: Group A received task-oriented training, and Group B received proprioceptive neuromuscular facilitation (PNF) technique. Upon comparing pre- and post-test results, Group A demonstrated more significant improvements than Group B (Rajalaxmi, V et al., 2021).

Strength of the Study:

One strength of our study was that both Whole Body Vibration (WBV) and Proprioceptive Neuromuscular Facilitation (PNF) therapy were provided to patients. While the PNF technique group also exhibited reductions in spasticity and improvements in lower extremity function, the WBV group was found to be more effective for children with cerebral palsy.

LIMITATION OF THE STUDY

The study encountered several limitations that must be acknowledged. Firstly, the sample size was relatively small, rendering it imprudent to generalize the findings to a larger population. Furthermore, the analysis was confined to assessing the short-term effects on spasticity reduction and lower extremity function. Consequently, the study's protocol spanned only a duration of six weeks, impeding a comprehensive evaluation of the long-term benefits.

CONCLUSION

The study findings indicate that Group A, which underwent Whole Body Vibration, exhibited more substantial improvements in spasticity reduction (Mean Difference: MMAS LL = 2.33, MMAS RL = 2.25) and lower extremity function enhancement (Mean Difference = 31.67) compared to Group B, which received Proprioceptive Neuromuscular Facilitation (Mean Difference: MMAS LL = 2.91, MMAS RL = 2.91) for spasticity and (Mean Difference = 21.41) for lower extremity function. Therefore, it can be concluded that Whole Body Vibration is the preferred approach for reducing spasticity and improving lower extremity function in children with cerebral palsy.

FUTURE SCOPE

It can be easily assessable in clinical settings. Whole Body Vibration can be compared with other techniques and effectiveness can be observed. An identical study can also be carried out in other Neurological Conditions. This study can be carried out in larger sample size.

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