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Effect of Neuro-Development Treatment with Roods Approach on Posture Control and Balance in Cerebral Palsy Children

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Abstract

Introduction: Cerebral palsy is a collection of permanent movement and postural impairments that limit activity and are caused by non-progressive abnormalities in a foetus' or child's growing brain. In children with cerebral palsy, neurodevelopmental therapy (NDT) and roods approach treatments are utilised individually to improve postural control and balance (CP).

Aim: To study the combined effects of Neuro-developmental treatment (Bobath concept) and Roods approach on postural control and balance in cerebral palsy children.

Methods: The study was comprised thirty children, divided into two groups, ranging in age from five to fifteen years. NDT with Roods approach was given to the experimental group, while NDT with Muscle stimulator was given to the control group for only 8 weeks. GMFM-88 was used to assess gross motor functions, PBS was used to assess balance, MTUGT was used to measure posture control, and SPCM was used to assess posture control.

Results: There was significant improvement in the outcomes measures within both the groups individually while between group analysis of outcome measures was not significant.

Conclusion: 8-week NDT based posture and balance training applied to children with cerebral palsy improved their functional motor levelalong with postural control skills, however application of roods approach also has been found effective in this study.

Keyswords: *Cerebral palsy, NDT, roods approach, muscle stimulator, rehabilitation.*

Introduction

"Cerebral palsy/spastic cp" is a general motor disability among juvenile in India, impacting three in every 1000 live births. This condition is multifaceted, influencing various developmental aspects such as motor skills, sensory perception, cognitive functions, language abilities, executive functions, and behaviour. The risk factors for CP include congenital brain defects, genetic predispositions, infections during pregnancy, and post-birth traumatic brain injuries.

The progression and management of CP are influenced by the severity of the condition, the timeliness of interventions, parental involvement, family support, and the opportunities for juvenile to practice motions in their daily environments. Achieving motor milestones and enhancing functionality in juvenile of spastic cp/cerebral palsy necessitates a comprehensive approach, involving a multidisciplinary competent team who work together to

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improve quality of life for both the affected juvenile and their household.

Globally, developmental experts form interdisciplinary teams to cater to the varied needs of juvenile with CP, aiming to bring about significant improve in their overall well-being. By emphasizing early detection, timely intervention, and ongoing support, these professionals strive to optimize outcomes and provide juvenile with CP the best possible opportunities for growth and development.(1)

"Cerebral palsy/spastic cp" is an unprogessive functional disorder that impact the developing central nervous system, particularly motor neurons. It can occur during pregnancy, delivery, or the perinatal period. Juvenile with CP experience various motor abnormalities and face numerous health, emotional, and social challenges.(2)

The "Pediatric Health Information Systems/PHIS" database is an management resource which includes dossier from over 41 charitable discreet triennial juvenile's medical center in the United States/US. These medical center are associated with the Juvenile's Hospital Association in Washington, D.C. To ensure data quality and solidity, the Juvenile's Hospital Association conducts regular audits and reviews of the data from each participating hospital. Although the PHIS database includes billing codes for inpatient physical therapy, there is a scarcity of inspect inpatient conditioning therapy services. This database offers a valuable opportunity to study the provision of in patient physiotherapy services to a overpopulated of baby with spastic CP who undergo orthopedic surgery in US hospitals. The aim of conduct was to examine the variability in the receipt of inpatient physiotherapy build on hospital-level and individual characteristics, as well as to characterize surgeries by the orthopedic for the lower bodies in individuals with spastic cp/cerebral palsy.(3)

Neuro-developmental Treatment

The innovative approach known as Neuro-Developmental Treatment (NDT) was pioneered "by physical therapist Berta Bobath" along with neuropsychiatrist "Karel Bobath". This method has significant influenced therapy techniques for little one with cerebral palsy/spastic cp and have been widely adopted in fields of physical, occupational, and speech therapy for over five decades.

NDT focal point on the "sensorimotor components of muscle tone, reflexes, and motion patterns". The Bobaths modeled this approach to address the underlying central nervous system dysfunction that impedes normal motor development in juvenile with CP. By targeting these fundamental aspects, NDT aims to enhance "motor control and function abilities", enhancing the quality of life for juvenile with spastic cp/cerebral palsy.

Through their teachings, writings, and training courses, the Bobaths emphasized the importance of establishing normal motor function and preventing contractures and abnormalities in juvenile with CP. Their approach involved inhibiting spastic and aberrant reflexes while facilitating normal muscle tone and motion patterns through specific handling techniques. By targeting key components such as postural control, perception, and memory, the neurodevelopmental treatment provided a comprehensive strategy to address the motor issues associated with cerebral palsy.(4)

Electric Stimulation

Electrical stimulation is a technique that has been around for a long time. It was first utilised by the Ancient Greeks, who used rubbed amber and torpedo fish to elicit a variety of physiological responses, most notably muscle contractions. Its creation coincided with improvements in physics made by Volta and Faraday in the 18th and 19th centuries, which resulted in more reliable, controllable sources of electricity, as well as advances in neurophysiology made by Femalevani and Duchenne. Following this, researchers discovered that denervated muscles only responded to stimulation by connecting and disconnecting a direct current source, rather than alternating current. Muscle contraction has been reported to occur in upper motor neuron disorders such as cerebral palsy (CP) when an intact motor neuron is stimulated with an alternating current. Threshold electrical stimulation, where the muscle is not activated, to neuromuscular electrical stimulation (NMES), where the muscle is contracted, are all examples of electrical stimulation. (5)

Roods Approach

Developed by Margaret Rood in the 1940s, the Rood approach is a neurophysiological technique centered on the activation and deactivation of sensory receptors. This method takes into account the interplay between "somatic, autonomic, and psychic factors in the regulation of motor behaviour". "The Rood techniques is one of mixed neuro-facilitation techniques/NFT employed by expert rehabilitation". Other notable methods include the "Brunnstrom technique, proprioceptive neuromuscular facilitation, and neurodevelopmental treatment (NDT), also known as the Bobath Approach". These techniques

are used to enhance motor function and enhance quality of life for human with neurological impairments.[6]

Methodology

This study aims to investigate the effectiveness of neurodevelopmental treatment/NDT combined with either muscle stimulation or the Rood approach in juvenile with cerebral palsy/spastic cp. The study was conducted b/w Nov 2023 to Jan 2024 at Pratyaksh Medical Care in Indrapuram, Ghaziabad (U.P), with proper permissions obtained.

Study Model: Experiment Study

Study Population & Sample: Juvenile with cerebral palsy/spastic cp age five-fifteen yrs, both male and female.

Place of Data Collection: Pratyaksh Medical Care in Indrapuram, Ghaziabad (U.P).

Sampling Method: Convenient Sampling

Sample Size: 30 participants, with 15 in each factor

Participants: Juvenile with cerebral palsy age five-fifteen yrs, GMFCS Level I, II, or III, who are cooperative and able to walk freely or with a mobility aid.

Selection Criteria:

- **Inclusion Criteria:**
  - Parents/legals representatives consenting to their child's participation
  - Diagnosis of cerebral palsy
  - Ages 5-15 years
  - Cooperative behavior
  - Ability to "walk freely or with a mobility aid (GMFCS Level I, II, or III)"
- **Exclusion Criteria:**
  - Different diagnosis than cerebral palsy
  - Inability to "walk freely or with a mobility aid (GMFCS Level IV or V)"
  - Irregular attendance at assessments or therapy sessions

Independent Variable: Neurodevelopmental treatment with the Rood approach

Dependent Variable: Effectiveness of neuro-developmental treatment with muscle stimulation

- **Treatment:**
  - **Factor A (control):** Neurodevelopmental treatment combined with muscle stimulation
  - **Factor B (experiment):** Neurodevelopmental treatment combined with the Rood approach
- **Assessment Tools:**
  - "Gross Motor Function Measure Classification System/GMFMCS"
  - "Gross Motor Function Measure -88/GMFM-88"
  - "Pediatric Balance Scale/PBS"
  - "Modified Timed Up and Go Test/MTUGT"
  - "Seated Postural Control Measure/SPCM"

Intervention Duration: 8 weeks, with sessions lasting 45 minutes, 3 days a week

Muscle Stimulation Parameters: Electrical stimulation applied to "paravertebral muscles, gluteus maximus, and quadriceps, for 10 mins/muscle, 3 days/week". Parameters adjusted based on tolerance.

Both factors will undergo face-to-face assessments prior and subsequent the intervention using the mentioned scales. Data will be collected through registration forms detailing demographics, CP clinical type, medical history, etc.

Between November 2023 to January 2024, a study was conducted at Pratyaksh Medical Care, following proper permissions. Explicit approval forms were obtained from all wellspring, and the study acquired approval from SANSKRITI College in October 2023. The study involved 30 participants, spilt into two factors of 15 each. Factor A acquired Neuro development treatment combined with Muscle stimulator (control factor), while Factor B acquired Neurodevelopmental treatment combined with Roods approach (experiment factor). Various assessment scales, including "GROSS MOTOR FUNCTIONMEASURE CLASSIFICATION SYSTEM/GMFMCS, GROSS MOTOR FUNCTIONMEASURE -88/GMFM-88, PEDIATRIC BALANCE SCALE/PBS, MODIFID TIMED UP AND GO TEST/MTUGT, and SEATED POSTURAL CONTROLMEASURE/SPCM", is used to appraise all subjects. "Each participant's details, including demographics, CP clinical type, limb involvement, medical history, mobility aid use, surgical history, and NDT history, were recorded in a registration form". Assessments were conducted prior and subsequent the intervention through face-to-face interactions with a physiotherapist using the mentioned scales. Both factors acquired training sessions lasting 45 minutes, three days/week, for 8 weeks. In Factor A, Neuro development treatment/NDT combined with Muscle stimulator was administered for 45 mins, three days/week, for 8 weeks, with NDT for 15 minutes and ES for 30 minutes thrice a week on 15 subjects. In Factor B, Neurodevelopmental treatment combined with Roods approach was provided for 45 minutes, three days a week,

for 8 weeks, with a combined therapy of NDT with ROODS approach for 45 minutes thrice a week on 15 subjects.

- **Factor A (Control Factor) Treatment Protocol:**
  - Combination of neurodevelopmental treatment (NDT) and muscle stimulation.
  - Neuro development treatment includes various weight-bearing tasks such as squatting, kneeling, half kneeling, quadruped, and one leg standing.
  - Dynamic balance training on a balance board, eye-hand coordination activities, and function or circuit training are incorporated.
  - Step up and down tasks with different levels of support and symmetry are performed.
  - Muscle stimulation is applied to the paravertebral muscles, gluteus maximus, and quadriceps.
  - Electrical stimulation is given for 10 mins/muscle, 3 days/week, for 8 weeks.
  - Parameters such as waveform, pulse duration, frequency, stimulation time, ramp up and down, and intensity are adjusted based on the child's tolerance.
- **Factor B (Experiment Factor) Treatment Protocol:**
  - Combination of neurodevelopmental treatment (NDT) and the Roods approach.
  - Similar weight-bearing tasks as in Factor A but performed on a sensory mat.
  - Vestibular and proprioceptive training using a balance board, sensory mat, trampoline, and exercise balls of different sizes.
  - Supplementary techniques such as slow stroking on the lower limb, vibration, light and heavy joint compression, and traction on the joint are applied.
  - Myo-therapy with stretching and ball press tasks are included.
  - Eye-hand coordination activities, function training, and step up and down tasks with various levels of support and symmetry are part of the intervention.

Both treatment protocols aim to enhance motor function in juvenile with cerebral palsy/spastic cp, but they utilize different approaches and techniques. Factor A focuses on customary NDT combined with muscle stimulation, while Factor B incorporates supplementary sensory-based interventions and techniques from the Roods approach. These variations allow for a comparison of the effectiveness of the two treatment approaches in improving motor function and other evaluation measure in juvenile with cerebral palsy/spastic cp.

Figure No. 1: Coordination tasks (Tandem walking) on ply wood

Figure No. 2: Ball Press

Figure No. 3: Training on balance board in sitting

Evaluation Measure

Gross motor function were assessed using the "Gross Motor function Classification System/GMFCS and the Gross Motor functionmeasure-88/GMFM-88". The GMFCS categorizes juvenile with age of 18 with cerebral palsy/ spastic cp into five levels based on their function abilities and limitations across four age categories. "These levels represent significant variations in gross motor function that impact the daily lives of juvenile with spastic cp/ cerebral palsy". "The GMFM-88 comprises 88 items distributed across five dimensions: lying and rolling, sitting, crawling and kneeling, standing, and walking, sprinting, and jumping'.

Balance skills were appraised using the "Modified Timed Up and Go Test/MTUGT and the Pediatric Balance Scale/PBS". During testing, juvenile were allowed to wear their comfortable clothing, modified foot wears and prosthetics if required, use their mobility aids as needed.

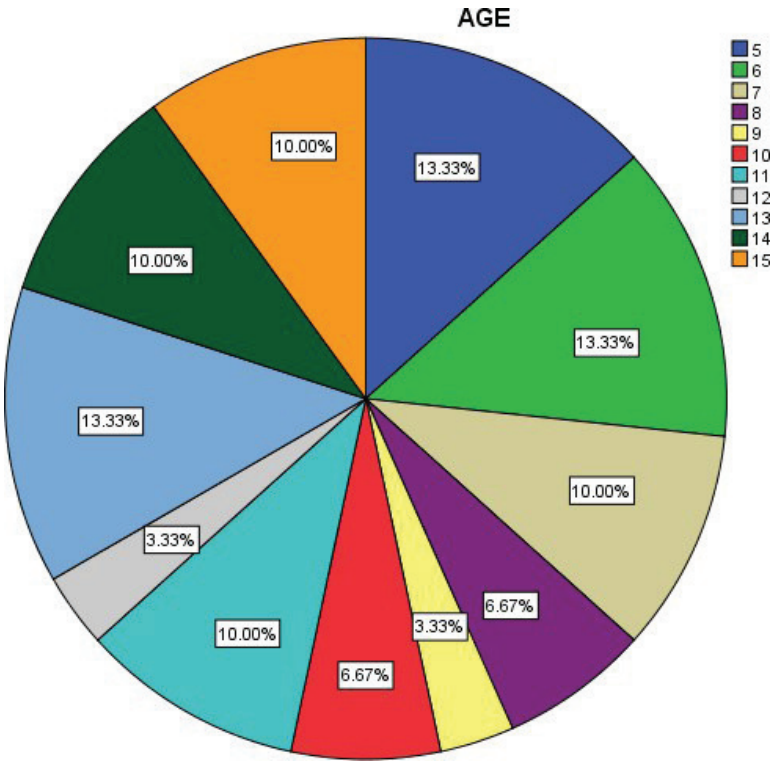
For the MTUGT, participants were instructed: "This test appraises your ability to stand up, walk, touch the cone, and return to a seated position." A stopwatch, such as one on a cell phone, was used to Measure the time. Participants could wear their regular shoes or orthotics and use a mobility aid if necessary but were not permitted to acquire support from person to person during the test. There is no limitation of time, and participants could take breaks if needed but were not allowed to sit down. The instructions emphasized mobility instead of running, and the examiner recorded the time from when the child stood up from the seat until returning to a seated position.

Result

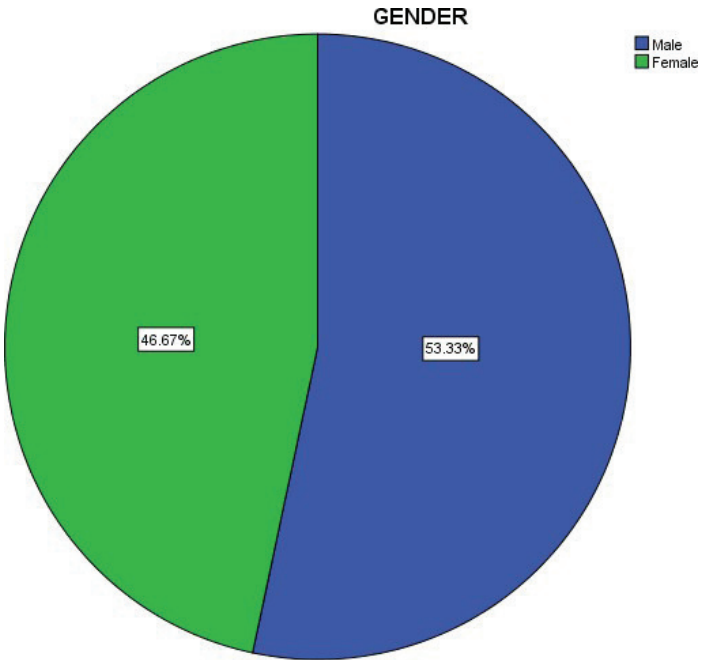
Table1: Demographics Characteristics of the participants

Demographics	Mean+SD	Skewness/skew[X] (Z-Estimate)	Kurtosis/β2 (Z-Estimate)	Shapiro-Wilk/[SW] (p-estimate)
Age	9.81+3.55	0.09	-1.84	0.009

In this table mean, standard deviation, skewness/skew[X], kurtosis/β2 , and p-estimate of demographics of the participants has been shown.



Graph 1: Pie diagram shows the age frequency in this study.



Graph 2: Pie diagram shows gender frequency in this study.

Table 2: Shows normality of the evaluation measuresGMFM-88, SPCM (LSS), SPCMA, SPCMF, PBS, MTUGT

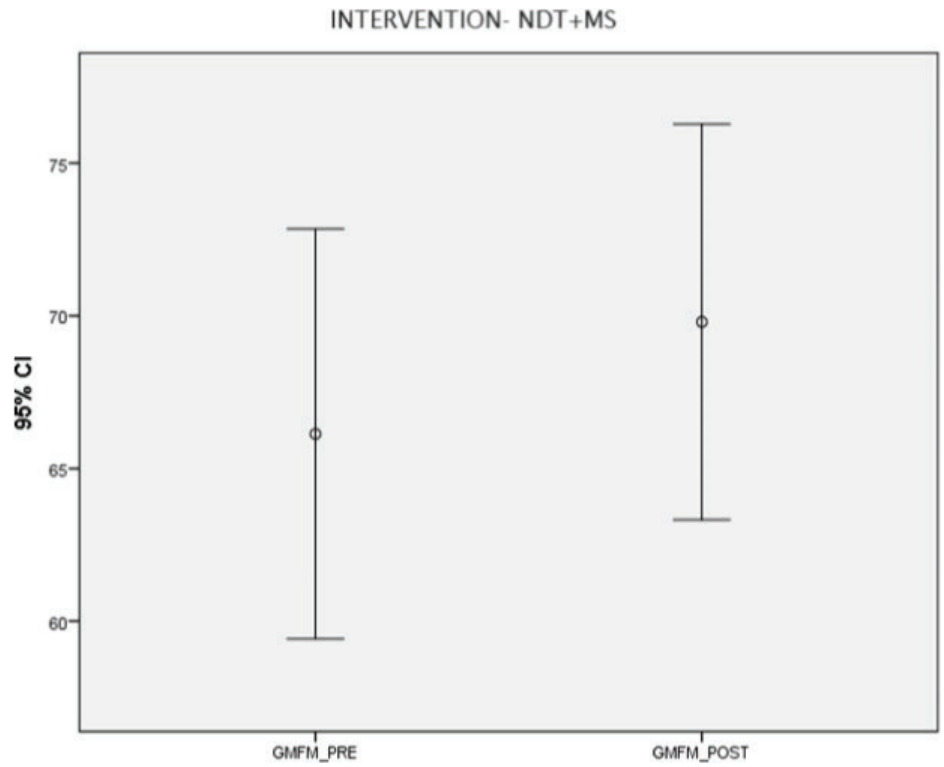
Evaluation measure	Mean ±SD	Skewness/skew[X] (Z Estimate)	Kurtosis/β_2 (Z-Estimate)	Shapiro-wilk/[SW] (p- estimate)
GMFM Pre	67.48±11.9	-0.23	-1.20	.090
GMFM Post	71.68±11.82	-0.15	-1.06	.305
SPCMLSS Pre	6.12±1.23	0.602	-1.270	.000009
SPCMLSS Post	7.18±0.85	0.956	0.384	.00005
SPCMA Pre	36.46±2.27	0.619	-0.865	.002
SPCMA Post	38.24±2.41	0.518	-0.555	.053
SPCMF Pre	33.96±7.71	-0.417	-0.906	.003
SPCMF Post	36.44±7.28	-0.557	-1.004	.107
PBS Pre	20.64±11.03	0.606	-0.489	.007
PBS Post	23.5±11.33	0.759	-0.394	.012
MTUGT Pre	49.26±28.82	0.818	-0.114	.006
MTUGT Post	48.98±28.72	0.622	-0.497	.002

Interpretation: In the interpretation provided, the focus is on describing the distribution of evaluation measurements using various" statistical parameters such as mean, standard deviation, skewness/skew[X], and kurtosis/β2

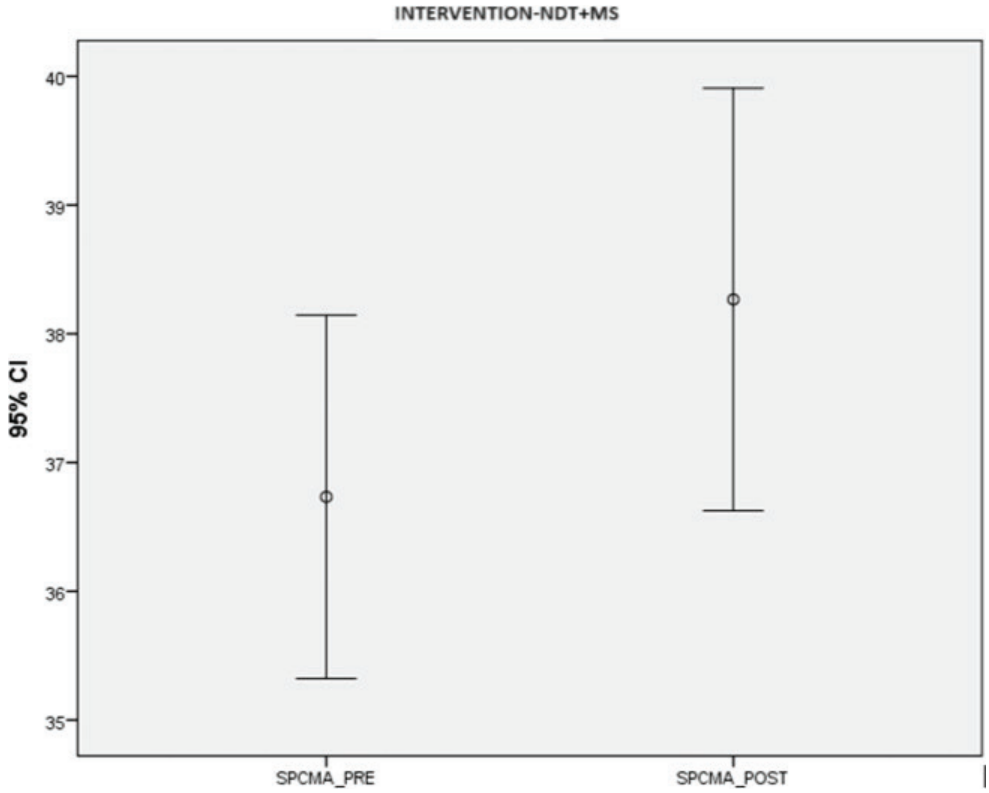
Firstly, it's mentioned that in the specific SPCM LSS evaluation measure, the data with p-estimates less than 0.05 is considered not normally distributed. This implies that for this particular evaluation measure, there is evidence to propose that the data deviates from a normal distribution at a statistically significant level.

On the other hand, for the remaining evaluation measures, it's stated that "the data is normally distributed with a p-estimate greater than (p>0.005)". "This announces that there is no statistically significant evidence to reject the null hypothesis that the data follows a normal distribution for these evaluation measure".

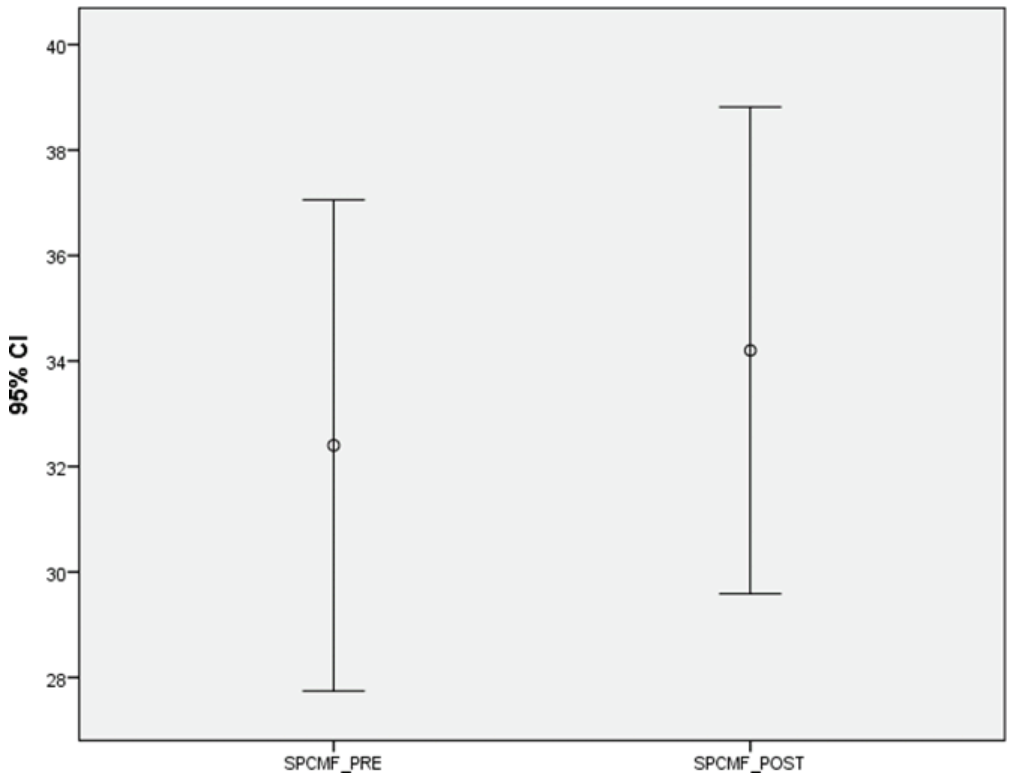
Overall, this interpretation proposes that while there may be some deviations from normality in one specific evaluation measure (SPCM LSS), the majority of the evaluation measures exhibit normal distribution characteristics based on the provided statistical analyses.



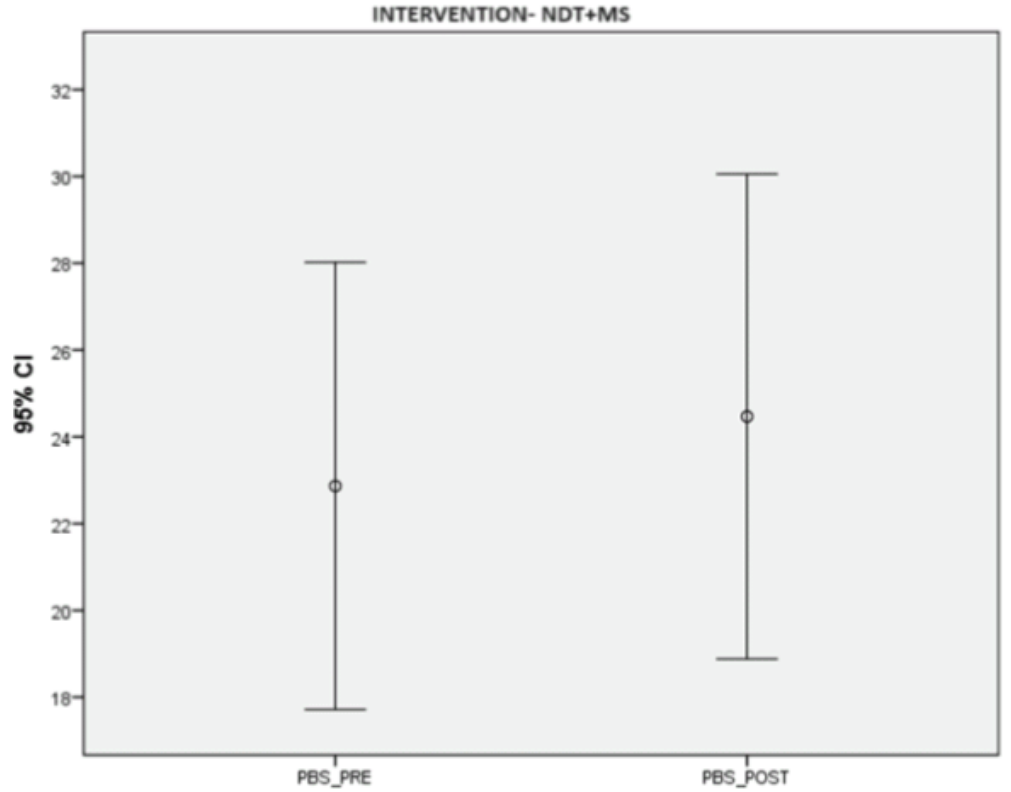
Graph 3: In factor 1,a graphical representation of the evaluation measure GMFM at beginning and after intervention was provided as an error bar graph with a 95 percent confidence interval.



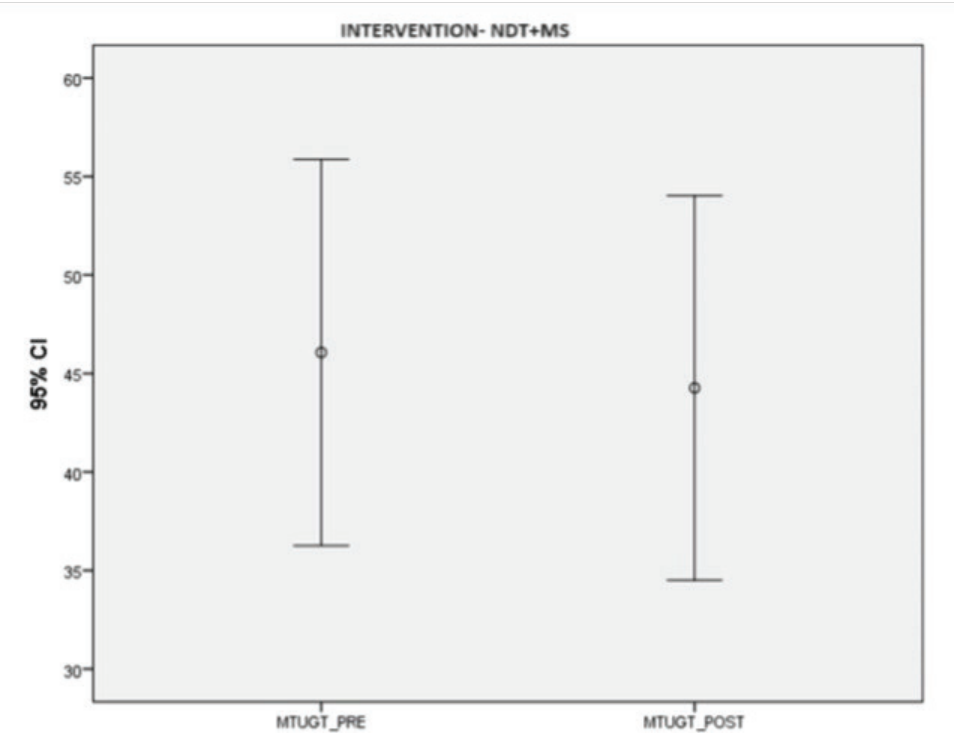
Graph 4: In factor 1, a graphical representation of the evaluation measure SPCMA at beginning and after intervention was provided as an error bar graph with a 95 percent confidence interval.



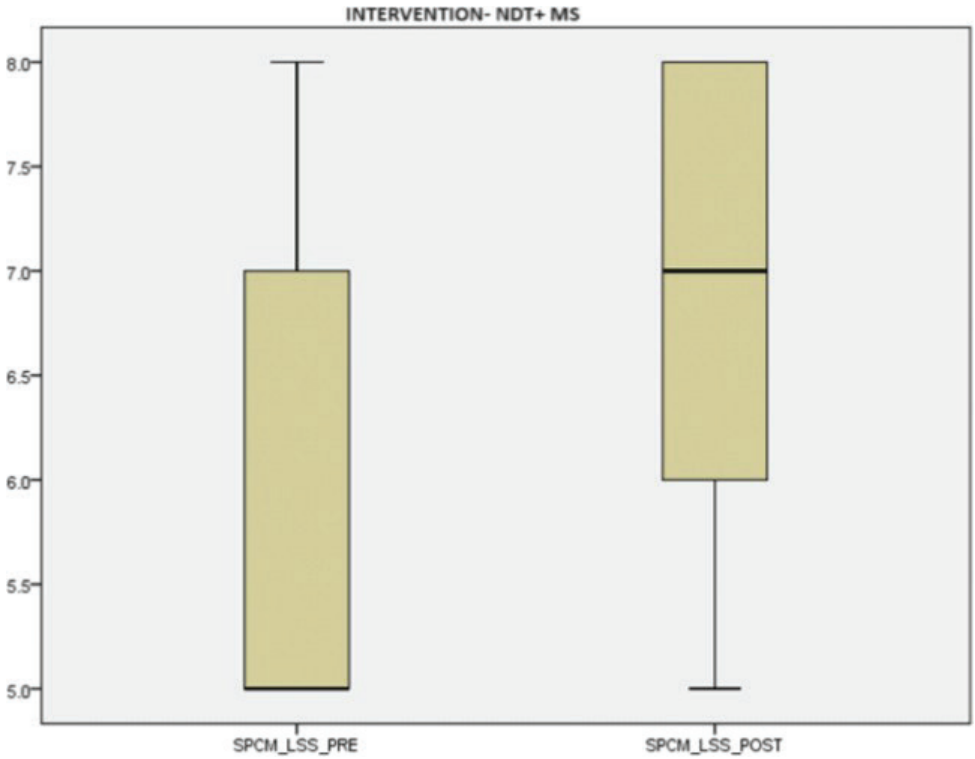
Graph 5: In factor1, a graphical representation of the evaluation measure SPCMF at beginning and after intervention was provided as an error bar graph with a 95 percent confidence interval.



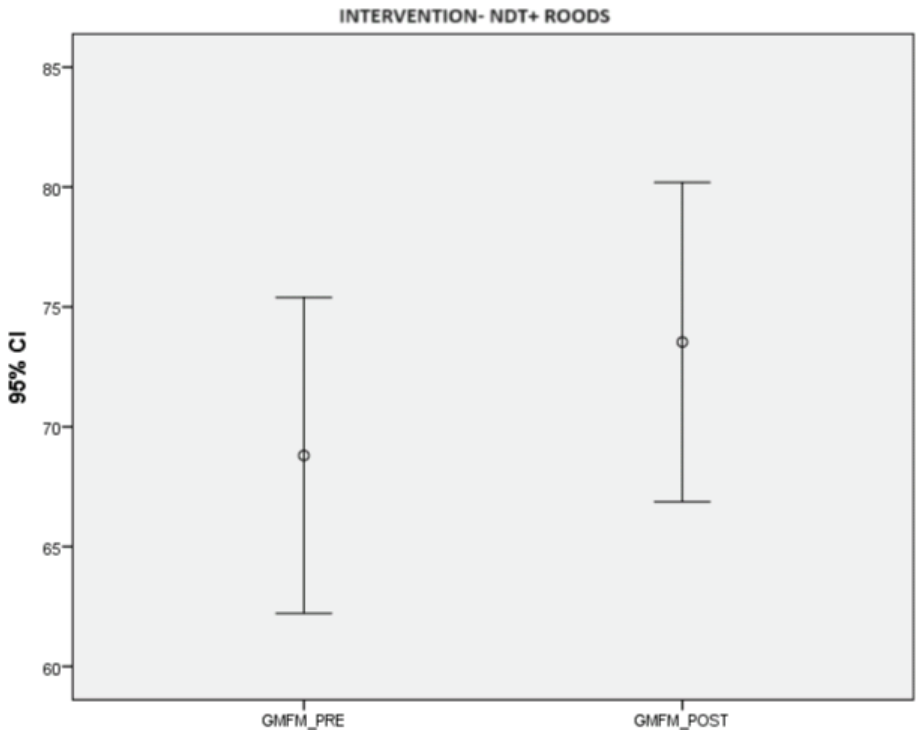
Graph 6:In factor1,a graphical representation of the evaluation measure PBS at beginning and after intervention is provided as an error bar graph with a 95 percent confidence interval.



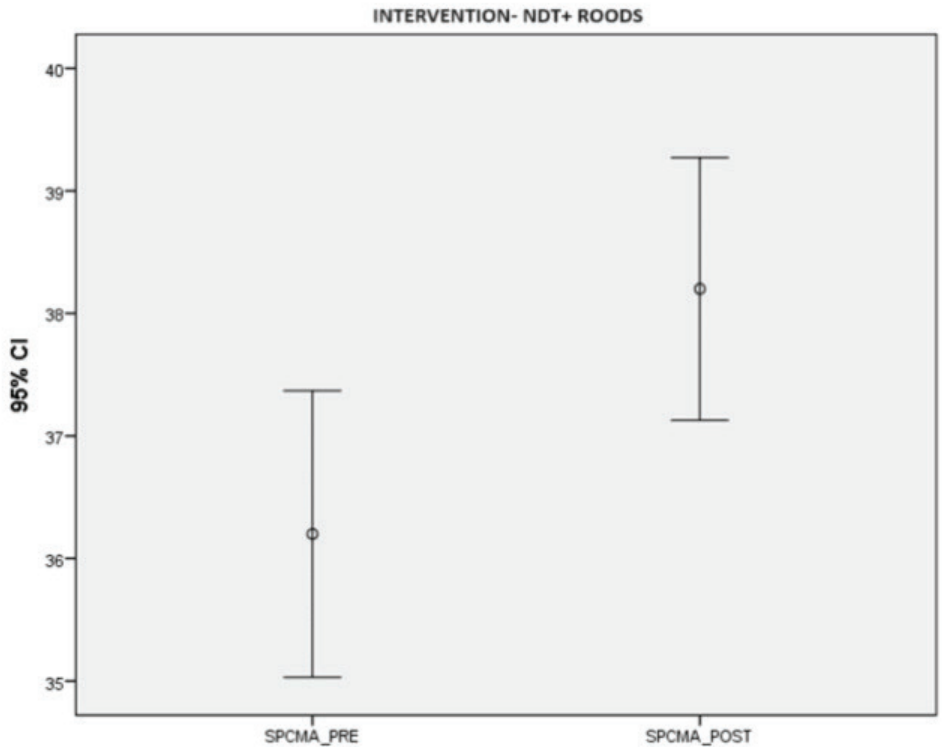
Graph 7: In factor 1,a graphical representation of the evaluation measure MTUGT at beginning and after intervention was provided as an error bar graph with a 95 percent confidence interval.



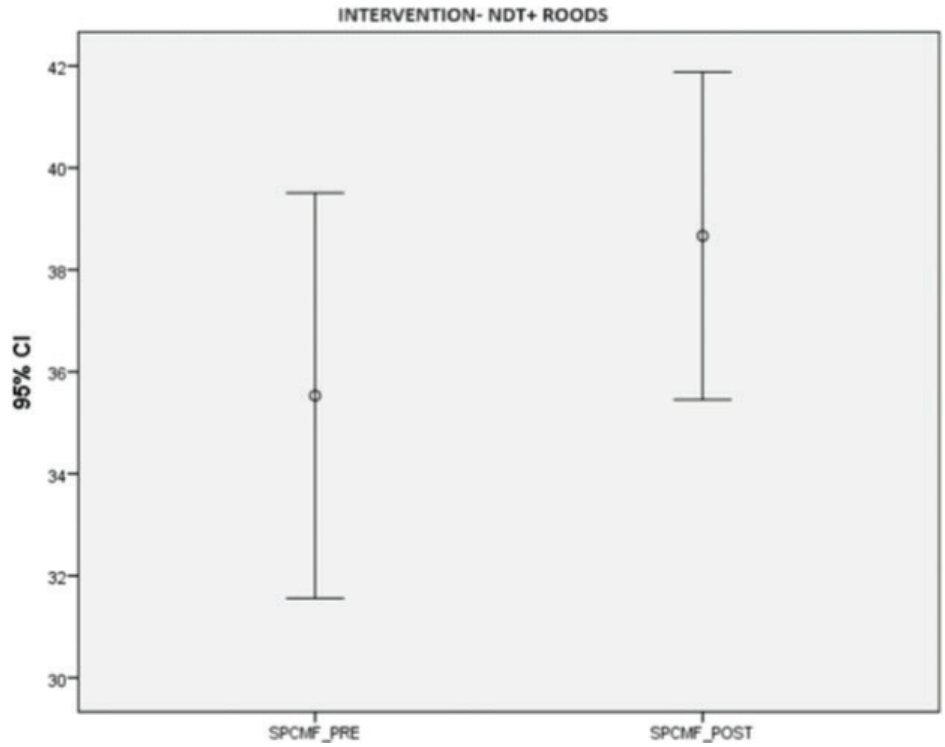
Graph 8: The SPCM LSS in factor 1 (NDT and MS) box and whisker plot is shown. The interquartile range is represented by each box (25th, 75th quartile). Themedianscoreisrepresentedbythehorizontalline(50thquartile).Infactor1, the whiskers represent the SPCM LSS Range (MIN-MAX)/R(^-ᵛ) at beginning and after intervention.



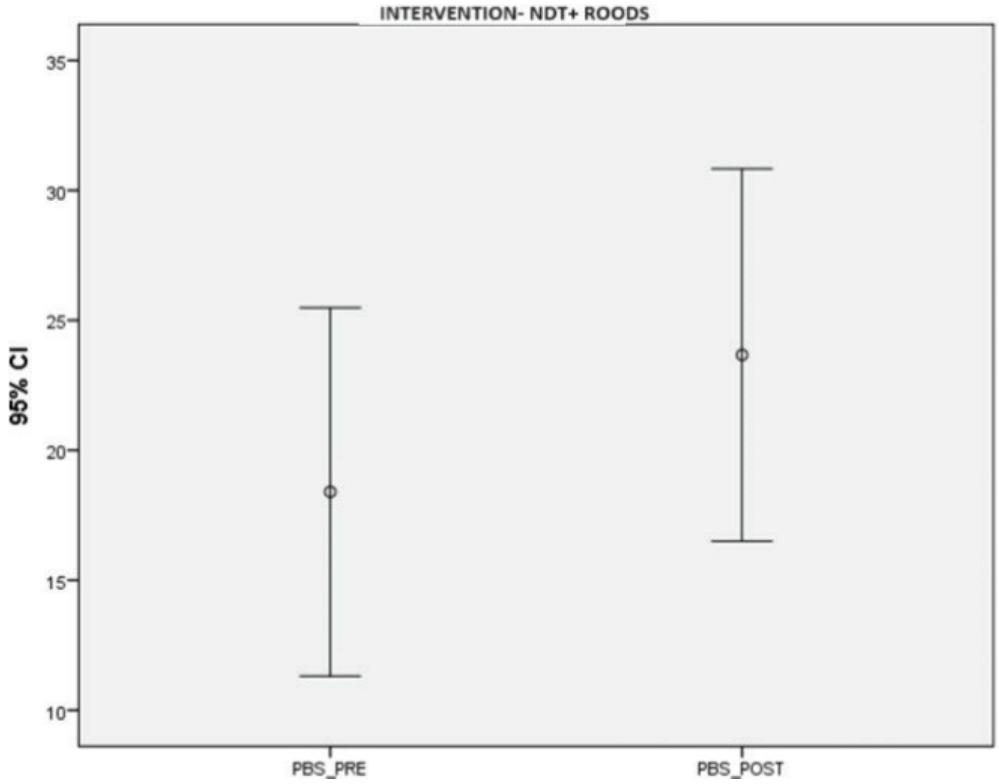
Graph 9: In factor2,a graphical representation of the evaluation measure GMFM at beginning and after intervention was displayed as an error bar graph with a 95 percent confidence interval.



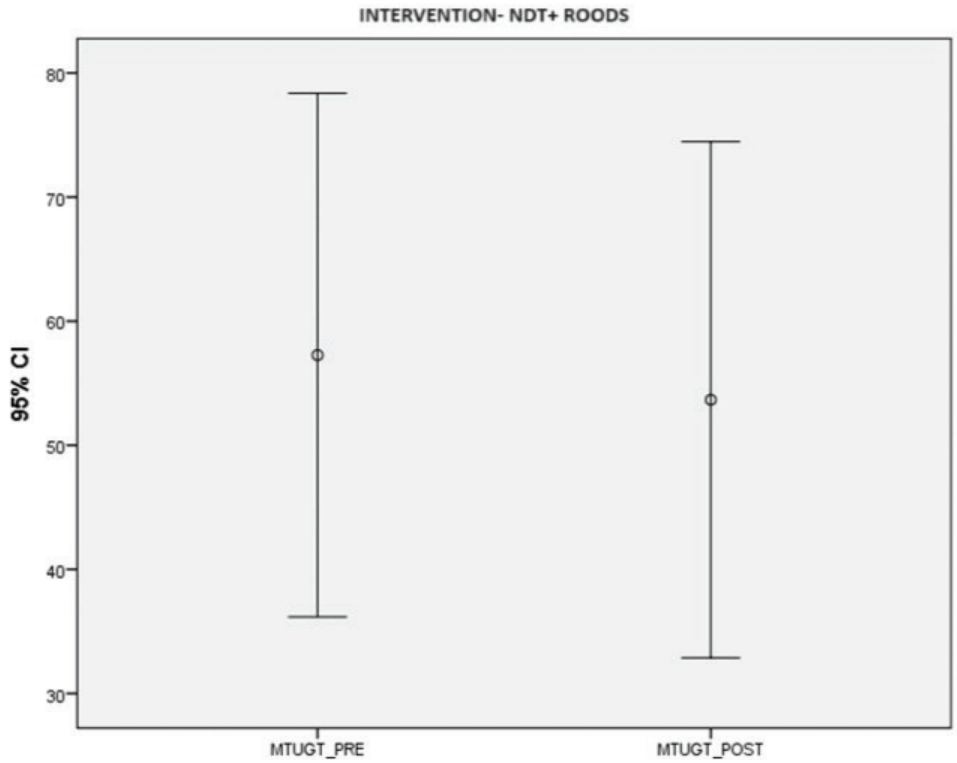
Graph 10: In factor 2, a graphical representation of the evaluation measure SPCMA at beginning and after intervention was displayed as an error bar graph with a 95 percent confidence interval.



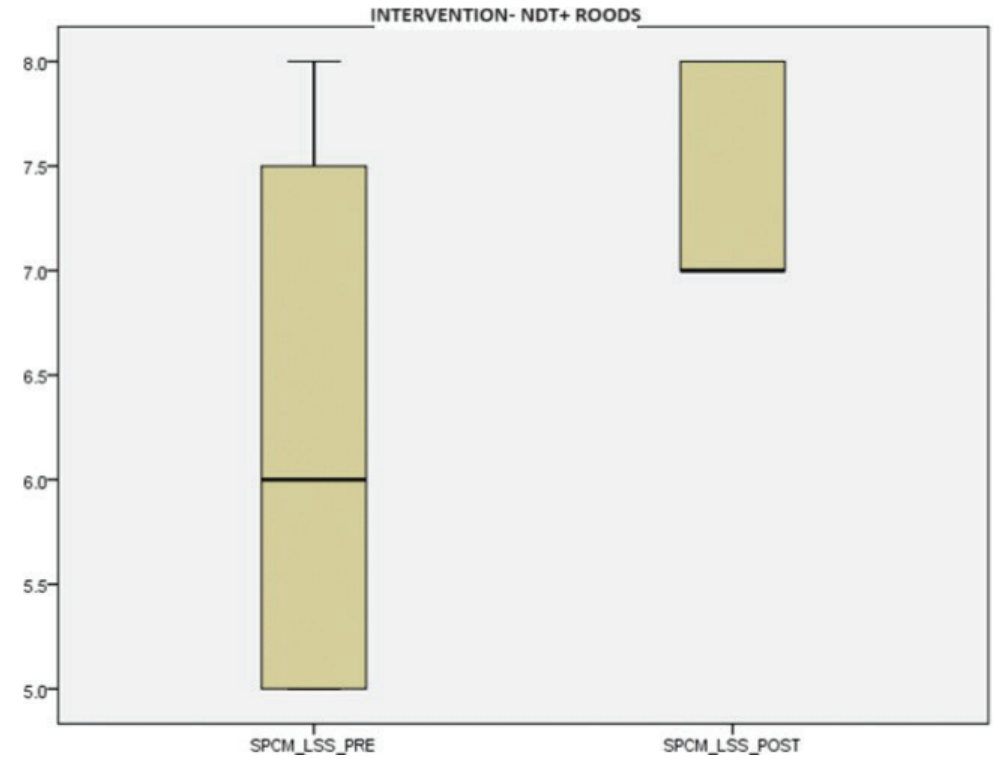
Graph 11: In factor 2, a graphical representation of the evaluation measure SPCMF at beginning and after intervention was displayed as an error bar graph with a 95 percent confidence interval.



Graph 12: In factor 2, a graphical representation of the evaluation measure PBS at beginning and after intervention was displayed as an error bar graph with a 95 percent confidence interval.



Graph 13: In factor 2, a graphical representation of the evaluation measure MTUGT at beginning and after intervention was displayed as an error bar graph with a 95 percent confidence interval.



Graph 14: The SPCM LSS in factor2(NDT and Roods approach)box and whisker plot is shown. The interquartile range is represented by each box(25th,75thquartile). The median score is represented by the horizontal line (50th quartile). The whiskers reflect the SPCM LSS Range (MIN-MAX)/R(^-ᵛ) at beginning and after intervention.

Table 3: Results of evaluation measure in the Control (Neuro- developmental treatment and Muscle stimulator) and Intervention factors were compared (Neuro- developmental treatment and Roods approach)

Evaluation measure	NDT and MS Mean(95%CI)	NDT and Roods Mean(95%CI)	p-Estimate
GMFM Pre	66.14 (59.43,72.83)	68.81 (62.22,75.38)	0.548
GMFM Post	69.81 (63.31,76.29)	73.55 (66.88,80.20)	0.396
SPCMA Pre	36.74 (35.33,38.15)	36.20 (35.04,37.38)	0.538
SPCMA Post	38.26 (36.64,39.92)	38.21 (37.17,39.28)	0.942
SPCMF Pre	32.41 (27.75,37.07)	35.54 (31.57,39.52)	0.282
SPCMF Post	34.20 (29.59,38.823	38.68 (35.46,41.89)	0.100
PBS Pre	22.86 (17.72,28.01)	18.41 (11.32,25.48)	0.283
PBS Post	24.48 (18.89,30.07)	23.66 (16.51,35.84)	0.852
MTUGT Pre	46.08 (36.27,55.9)	57.26 (36.18,78.37)	0.311
MTUGT Post	44.28 (34.31,45.09)	53.68 (32.88,74.48)	0.388

Interpretation: The interpretation provided summarizes the statistical analysis conducted for evaluation measure with normal distributions in both factors.

Expressive statistics, such as "the mean and 95 percent confidence interval", were calculated for the evaluation measure, which was assumed to follow a normal distribution in both factors. These expressive statistics help to understand the central tendency and the precision of the estimates.

Inferential statistics, specifically the independent t-test, were then employed to assess the significant level between the factors at both beginning and post-intervention stages. "The independent t-test is appropriate for comparing means b/w 2 independent factors when the assumption of normality is met".

The result of the analysis announced that there was no significant variations observed in any of the evaluation measure when comparing beginning and post-intervention data between the two factors. This proposes that the interventions implemented in both factors did not lead to statistically significant changes in the evaluation measures.

Overall, this interpretation highlights that despite conducting thorough statistical analyses, there were no significant variations observed b/w the factors in terms of the evaluation measure, indicating that the interventions not have a statistically significant impact on the outcomes.

Discussion

The study was plan with aim to investigate and compare the effect of Neuro-Development treatment with Muscle stimulator and Neuro-Development Treatment with Roods approach to assess the postural control and balance in cerebral palsy child.

Neuro-Development Treatment with Muscle stimulator and Neuro-Development Treatment with Roods approach both are very essential component for enhancing the life and gross motor function of the lower limb. This is an experiment study in was done in Pratyaksh medical care. 15 subjects were taken of age factor 5yrs - 15yrs. These subjects were divided into two factors which were asked to follow protocol under the neurodevelopment treatment combines with muscle stimulator and neurodevelopment treatment combines with roods approach.

In this study, we assess the posture control and balance of the cerebral palsy child were seen from pre-treatment to post-treatment scoring done by GMFCS LEVEL, GMFM-88, PBS, MTUGT, SPCM.

In this study, subjects were spilt into two factors Factor A-Neuro-Development Treatment with Muscle stimulator and Factor B-Neuro-Development Treatment with Roods approach

In factor A were given Neurodevelopment treatment combines with Muscle stimulator was applied on control factor. Nero-Development Treatment was given for 15 mins and it includes weight bearing exercises like squatting, kneeling, half kneeling, quadruped, one leg standing for 5 mins. Dynamic balance training on balance board for 2 mins. Eye-hand coordination activities for 1 min. Functional training or circuit training 5 mins. Step up & down exercises (supported-unsupported, symmetric, reciprocal etc.) for 2 mins. Electric stimulation places on the spinal muscle/paravertebal muscle, buttock muscle/ glutes maximus and quadriceps/thigh for 10 mins.

In factor B were given Neurodevelopmental treatment combines with Roods approach was applied on experimental factor. It includes weight bearing exercises like squatting, kneeling, half kneeling, quadruped, one leg standing on sensory mat for 15 mins. Vestibular and proprioceptive training on balance board with sensory mat, trampoline and exercise balls in different sizes (peanut and swiss ball) for 10 mins. Slow stroking was given on lower limb by loofa, vibration, light joint compresion and heavy joint compression traction on joint for 5 mins. Myo-therapy was given on lower limb with stretching for 5 mins. Ball press exercise for 2 mins. Eye-hand coordination activities. Functional training or circuit training for 5 mins. Step up & down exercises (supported-unsupported, symmetric, reciprocal etc.) for 3 mins.

Results announced that Factor B, receiving NDT combined with Roods approach, showed better outcomes compared to Factor A. This proposes that the addition of Roods approach techniques to NDT may have a positive impact on postural control and balance in juvenile with cerebral palsy/spastic cp.

Limitations of the study: The limitations were small fragment amount of the study, Intervention was given to 8 weeks only and all types of cerebral palsied children were included in the study.

Future Scope: The Future Scope is to take larger sample size, for longer duration and in particular type of cerebral palsy.

Conclusion

The study acknowledged that the Neuro-developmental Treatment (NDT) combined with the Roods approach yielded superior results in enhancing postural control and balance in juvenile with cerebral palsy. This combined approach involved facilitating motions to ensure the integration of input from various sensory receptors, including tactile, vestibular, and somatosensory receptors, with the “central nervous system/CNS through mechanoreceptors”. By improving muscle strength and motor control, this approach led to enhanced postural control and balance, which are crucial for the independence of juvenile with cerebral palsy/spastic cp”.

Over the 8-week intervention period, the “NDT-based postural control and balance training significantly improving the functional motor level and postural control skills of the participants”. Notably, the application of the Roods approach alongside NDT further enhanced the effectiveness of the intervention, demonstrating its efficacy in improving posture control and balance in juvenile with cerebral palsy/spastic cp.

These findings underscore the importance of utilizing comprehensive and multidisciplinary approaches, such as NDT combined with the Roods approach, in the re-educate of juvenile with cerebral palsy/spastic cp. By addressing various sensory and motor aspects of motion control, these approaches can significantly contribute to improving function outcomes and enhancing the quality of life for juvenile with cerebral palsy/spastic cp.

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References

1. Sandeep Khanna ,Ranganathan Arunmozhi , Chanan Goyal Neurodevelopmental Treatment in Children With Cerebral Palsy: A Review of the Literature.(2023)
2. Włodzisław Kuliński[1], EwaAdamczyk PHYSICAL THERAPY IN CEREBRAL PALSY. CLINICAL ASPECTS. CASE REPORT. (2023)
3. Meireles, André L. F. Menegol, NatáliaA.Perin, Giovana A Sanada, Luciana Randomized clinical trials of physical therapy for cerebral palsy: a review of study outcomes, methodological quality, and publication merits.(2023)
4. Sahar Hassani, Joseph J Krzak, BarbaraJohnson, AnnFlanagan, George Gorton III,AnitaBagley,SylviaÕunpuu,MarkRomness,ChesterTylkowski,DonnaOeffingerOne-Minute Walk and modified Timed Up and Go tests in children with cerebral palsy: performance and minimum clinically important differences (2013)
5. Alemdaroğlu E, Yanıkoğlu İ, Öken Ö, Uçan H, Ersöz M, Köseoğlu BF, Kapıcıoğlu Mİ. Horseback riding therapy in addition to conventional rehabilitation program decreases spasticity in children with cerebral palsy: A

small sample study. Complementary therapies in clinical practice. (2016)

6. Veličković TD, Perat MV. Basic principles of the neurodevelopmental treatment.(2005)

7. Bailes,, Amy F. PT, PhD, PCS; Greve, Kelly PT, PhD, PCS; Long, Jason PhD; Kurowski, Brad G. MD, MS; Vargus-Adams, Jilda MD, MSc; Aronow, Bruce PhD; Mitelpunkt, Alexis MD Describing the Delivery of Evidence-Based Physical Therapy Intervention to Individuals With Cerebral Palsy.(2021)

8. Shah vidhi, Shilpakhandre, Effects of lower limb strength training on gross motor functions in children with cerebral palsy (2018)

9. Hekne L, Montgomery C, Johansen K. Early access to physiotherapy for infants with cerebral palsy: A retrospective chart review.(2021)

10. Park EY, Kim WH. Effect of neurodevelopmental treatment-based physical therapy on the change of muscle strength, spasticity, and gross motor function in children with spastic cerebral palsy. Journal of physical therapy science. (2017)

11. Gunel MK, Mutlu A, Tarsuslu T, Livanelioglu A. Relationship among the Manual Ability Classification System (MACS), the Gross Motor Function Classification System (GMFCS), and the functional status (WeeFIM) in children with spastic cerebral palsy. European journal of pediatrics. (2009)

12. Fetters L, Kluzik J. The effects of neurodevelopmental treatment versus practice on the reaching of children with spastic cerebral palsy. Physical therapy. (1996)

13. Arndt SW, Chandler LS, Sweeney JK, Sharkey MA, McElroy JJ. Effects of a neurodevelopmental treatment-based trunk protocol for infants with posture and movement dysfunction. Pediatric Physical Therapy. (2008)

14. Elanchezhian C, SwarnaKumari P. Swiss ball training to improve trunk control and balance in spastic hemiplegic cerebral palsy. Sri Lanka Journal of Child Health. (2019)

15. Olama KA, Elnahhas AM, Rajab SH. Effect of universal exercise unit on balance in children with spastic Diplegia. (2019)

16. Vidal A, de AzevedoFernandes JM, da Rosa Gutierres IC, da Silva FC, Silva R, GutierresFilho PJ. Effects of weekly hippotherapy frequency on gross motor function and functional performance of children with cerebral palsy: a randomized controlled trial. Motricidade. (2021)