MIFI
MAJALAH ILMIAH FISIOTERAPI INDONESIA
CASE REPORT
Volume 13, Number 1 (2025), Page 6-11
P-ISSN 2303-1921, E-ISSN 2722-0443

Advancing Mobility: Case Study on Neurodevelopmental Therapy for Improving Standing and Walking in Child with Global Developmental Delay

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Submitted: 09 June 2024 | Accepted: 09 October 2024 | Published: 15 January 2024
DOI: https://doi.org/10.24843/mifi.2025.v13.i01.p02

Abstract

Introduction: A child's growth and development are categorized into physical and developmental progress. Developmental delay occurs when a child experiences physical, cognitive, behavioral, emotional, or social delays. When delays involve more than two developmental domains, such as fine motor, gross motor, language, social, cognitive, and daily activities, it is classified as global developmental delay (GDD). Encephalitis is a brain inflammation that can disrupt early neurological development, leading to developmental impairments.
Method: This case of GDD was treated using neurodevelopmental treatment (NDT) techniques, including facilitating standing from a sitting position to walking, upright stimulation with toys, and assisted walking on an incline.
Results: After four therapy sessions, improvements were observed in upright standing activities, with the child standing for 1 minute at T1 and increasing to 3 minutes at T4. Walking on an incline also improved, with no willingness to stop at T1 but a willingness to stop for 10 seconds at T4. However, there was no improvement in the parachute reflex or functional activity as measured by the Gross Motor Function Measure (GMFM).
Conclusion: Significant improvement in children with special needs cannot be achieved with only four therapy sessions. Consistent, long-term therapy is required to achieve the desired outcomes, with family support playing a crucial role, as children spend more time with their families than in treatment.

Keywords: global developmental delay, encephalitis, neurodevelopmental treatment, gross motor function measure

Introduction

The early childhood stage, often called the "golden period", is marked by rapid growth and development, especially during the first 0.5 years of life. Child development is divided into two phases: growth, which refers to measurable physical changes, and development, which involves the increasing complexity of the body's structure and functions.[1] According to the World Health Organization (WHO), globally, 180-200 million children experience developmental delays each year, with 86% of these cases occurring in developing countries, compared to only 8% in developed nations. In developed countries, developmental delays are reported in 10-15% of children under the age of five, with global developmental delay (GDD) affecting 1-3% of this population.[2] According to national data from the Indonesian Ministry of Health 2016, 7,512.6 per 100,000 children under five (equivalent to 7.51%) in Indonesia experienced growth and developmental disorders.[1]

Several factors can lead to a diagnosis of GDD in children, including genetic causes like chromosomal abnormalities, environmental factors during pregnancy, and postnatal infections such as encephalitis, which can damage the central nervous system. Encephalitis is rarely reported as a primary cause of GDD because it is a relatively uncommon condition compared to other causes of developmental delay, such as genetic, metabolic, and chronic infections. Encephalitis is also not always correctly diagnosed or associated with GDD. Some patients may not experience significant developmental delays, especially if neurological symptoms are mild or if the child begins to recover after the acute phase of the illness.[3]

Therefore, more common factors are often considered in GDD cases. Encephalitis is inflammation of brain tissue, typically caused by infections (such as viruses), autoimmune reactions, or other factors. This condition can damage brain cells, and when encephalitis occurs in infants or young children whose brains are still developing, the resulting damage can lead to long-term neurological issues, including GDD. Brain damage from encephalitis affects a child's motor, language, cognitive, and social development, potentially causing delays across multiple developmental domains.[4]

The main issue in global developmental delay (GDD) cases is the delay in two or more developmental domains, including gross or fine motor skills, speech and language, cognitive abilities, personal-social interactions, and daily living activities.[5] The appropriate physiotherapy intervention for children with developmental delays is Neurodevelopmental Treatment (NDT). NDT is one of the most widely used approaches for treating children with developmental disorders and was developed by Dr. Karel Bobath and Mrs. Bertha Bobath. In this case, the author utilized NDT to assess the effectiveness of neural functions related to gross motor skills in children experiencing developmental delays.[6]

Method

This study is an experimental research with a case study design conducted at a pediatric clinic in Surabaya. The research involved a 5-year-old boy, An—R, who lives with his parents in an environment conducive to his recovery. The patient was born at term via cesarean section in 2019, received complete vaccinations, and consumed formula milk from ages 0 to 2 years. At 8 months old, the child experienced diarrhea, fever, and seizures and was subsequently taken to a hospital in Surabaya for examination. An electrocardiogram (EKG) was performed, and the diagnosis revealed mild encephalitis. The doctor recommended further treatment to prevent the progression of the disease. By the time the child was 2 years old, his parents began to notice delays in his development compared to his peers. Consequently, they decided to bring him to the pediatric clinic in Surabaya for therapy.

This study was conducted in January 2024 over 3 weeks with four sessions. During the anamnesis with the parents, it was concluded that the child had a social development disorder, specifically a speech delay. A specific examination was then conducted to assess the parachute reflex, a basic postural reflex in older infants. This reflex is triggered when a child, standing upright while being held by a caregiver, extends their arms forward and spreads their fingers like a parachute to prevent a fall. Functional activity was measured using the GMFM (Gross Motor Function Measure).

According to Beckers and Bastiaenen (2015), GMFM measurement assesses the child's level of independence, determining whether the child can perform daily activities independently, with partial assistance, or requires full support from others. The examination revealed motor development delays, including difficulties transitioning from sitting to standing, walking, and stopping. The child did not yet exhibit downward and sideward reflexes during walking, nor backward reflexes while standing and walking. Based on these findings, the therapist diagnosed the patient with global developmental delay due to encephalitis, given the two developmental delays and the history of encephalitis.[7]

Following the examination, the appropriate physiotherapy treatment for this case was the Neuro-Developmental Treatment (NDT) method, one of the most commonly used approaches for interventions in children with developmental disorders, created by Dr. Karel Bobath and Mrs. Bertha Bobath. In this case, the NDT method involved three techniques: Technique 1: facilitating standing from a sitting position on the floor to walking and stopping. This was achieved by having the child sit on the floor. The therapist provided stimulation to encourage the child to stand and walk and to practice falling, with eight repetitions followed by a 3-session rest period, each session lasting 5 minutes.

Figure 1. NDT Training Stages for Facilitating Standing from a Sitting Position on the Floor to Walking and Stopping

Technique 2: This involves stimulating upright standing using toys. The child stands while being encouraged to move a toy from side to side, from right to left, over two sessions, each lasting 5 minutes.

Figure 2. NDT Training Stages for Upright Standing with Toys

Technique 3: This involves facilitating walking on an inclined surface. The child is encouraged to walk on the inclined plane while holding the therapist's hand. During the walk, the child is prompted to stop and stand upright at intervals. This technique is repeated 3 times, with a rest period of 3 sessions, each lasting 2 minutes.

Figure 3: NDT Training Stages for Facilitating Walking on an Inclined Surface

After conducting four therapy sessions for the 5-year-old patient An. R, diagnosed with global developmental delay due to encephalitis, using the Neuro-Developmental Treatment (NDT) approach, the following results were obtained:

Table 1. Results of GMFM Measurement Evaluation

Dimension	T1	T2	T3	T4
Dimension A	100%	100%	100%	100%
Dimension B	100%	100%	100%	100%
Dimension C	100%	100%	100%	100%
Dimension D	71.7%	71.7%	71.7%	71.7%
Dimension E	47.2%	47.2%	47.2%	47.2%
Total	83.78%	83.78%	83.78%	83.78%

Table 1. Shows that the measurement of functional activity using the GMFM tool did not improve functional activity in Dimensions D and E.

Table 2. Results of Parachute Reflex Examination

Parachute Reflex	Position	T1	T2	T3	T4
Downward	Walking	(-)	(-)	(-)	(-)
Sideward	Walking	(-)	(-)	(-)	(-)
Backward	Standing	(-)	(-)	(-)	(-)
	Walking	(-)	(-)	(-)	(-)

Table 2. Shows that the parachute reflexes did not appear from T1 through T4.

Table 3. Results of NDT Method Evaluation for Facilitating Standing from a Sitting Position on the Floor to Walking and Stopping

Time Point	Standing Assistance	Stopping and Falling Assistance
T1	Maximum assistance	Minimal assistance
T2	Maximum assistance	Minimal assistance
T3	Maximum assistance	Minimal assistance
T4	Maximum assistance	Minimal assistance

Table 3. The NDT method for facilitating standing from a sitting position on the floor to walking and stopping did not show improvement from T1 to T4, as the child still required maximum assistance to stand from the sitting position on the floor and minimal assistance for stopping and falling.

Table 4. Results of NDT Method Evaluation for Upright Standing Stimulation

Time Point	Maximum Standing Time
T1	1 minute
T2	1 minute
T3	2 minutes
T4	3 minutes

Table 4. The NDT method with upright standing stimulation showed improvement, with the child initially standing for a maximum of 1 minute at T1, increasing to 2 minutes at T3, and 3 minutes at T4.

Table 5. Results of NDT Method Evaluation for Facilitating Walking on an Inclined Surface

Time Point	Observations
T1	Child did not want to stop on the incline
T2	Child did not want to stop on the incline
T3	Child began to show willingness to stop on the incline
T4	Child was able to stop on the incline for 10 seconds

Table 5. Shows that the NDT method for facilitating walking on an inclined surface resulted in improvement, with the child initially not wanting to stop on the incline at T1, starting to show willingness to stop at T3, and being able to stop on the incline for 10 seconds at T4.

Discussion

Based on the data presented in Table 3, the results of applying the NDT method to improve the ability to transition from a sitting position on the floor to standing upright for walking and stopping showed no significant change after four therapy sessions. The child still required maximum assistance to stand from a sitting position on the floor. This lack of progress could be attributed to several factors, including environmental factors, the level of stimulation provided, and the duration of therapy sessions. Additionally, education for the parents plays a crucial role, as the child spends more time with them than in therapy sessions. Therefore, parental education is essential to support the child's recovery process.[8]

Parents are advised to support the therapy process by engaging in activities that complement the therapeutic interventions. This includes using toys to motivate the child to walk by placing them at various distances to encourage reaching and movement. Taking the child to parks or playgrounds provides additional opportunities for walking and physical play in a stimulating environment. Additionally, limiting the child's use of gadgets is essential, as reducing screen time encourages more active play and interaction. These strategies help reinforce the skills learned during therapy and contribute to the child's overall development and recovery.

The study by Shamsoddini A. (2015), titled "Effects of Neurodevelopmental Therapy on Gross Motor Function in Children with Cerebral Palsy," explores how NDT can enhance gross motor function. This research involved 28 children with cerebral palsy, aged between 4.5 and 4.9 years, and was conducted with one hour of therapy per week over three months. The results concluded that NDT significantly improves gross motor functions in children, including rolling, crawling, sitting, kneeling, and standing.[9]

Based on the data in Table 4, the application of the NDT method for upright standing showed only modest changes over the course of 4 therapy sessions. The child demonstrated limited improvement with NDT stimulation, as the progress from the initial to the final sessions was relatively minor. However, the fourth evaluation observed a noticeable change, where the child could stand steadily for 3 minutes, compared to only 1 minute at the first evaluation. This indicates that while the improvements were gradual, the NDT intervention effectively enhanced balance and motor function.

Supporting this, research by Fadhil DIA et al. (2014) in the Sport and Fitness Journal demonstrates that NDT can improve standing balance. Their study, conducted over two months with 18 children with Down syndrome who had balance issues, found that NDT significantly enhanced their standing balance. This aligns with the findings in our study, suggesting that NDT effectively improves balance and motor skills in children.[10]

Another study conducted by Tekin et al. (2018) involved 15 children with cerebral palsy, aged between 5 and 15 years. The study utilized an NDT approach focusing on posture and balance exercises, with sessions lasting one hour each, conducted twice a week for eight weeks. The findings concluded that Neuro-Developmental Treatment (NDT) effectively enhanced motor function and functional independence by improving postural control and balance. This supports the effectiveness of NDT in developing crucial motor and functional skills in children with cerebral palsy.[11]

Based on the data in Table 5, the results of applying the NDT method for improving walking on an inclined surface showed only modest changes over four therapy sessions. While the child initially resisted stopping on the incline, by the fourth evaluation, the child could stand upright for 10 seconds. This indicates some progress, although the overall change was not highly significant.

Supporting these findings, a study published in the Cukurova Medical Journal concluded that Bobath Therapy could enhance functional motor skills, independence in activities of daily living, and balance. This study involved 15 children with cerebral palsy, including 7 with diplegia and 8 with hemiplegia. The therapy was administered for one hour per session, twice a week, for eight weeks. This research aligns with the notion that therapeutic interventions like NDT and Bobath Therapy can contribute to functional improvements in children with cerebral palsy.[12]

In the study titled "Effect of Neurodevelopmental Treatment-Based Physical Therapy on the Change of Muscle Strength, Spasticity, and Gross Motor Function in Children with Spastic Cerebral Palsy," the aim was to investigate the effectiveness of neurodevelopmental treatment (NDT) on muscle tone, strength, and gross motor function. This research involved 171 children with cerebral palsy, receiving treatment for 35 minutes per week over the course of one year. The results demonstrated a significant improvement in muscle strength, as evidenced by the comparison between Gross Motor Functional Classification System (GMFCS) levels I-II and levels III-IV.[13]

In the study by Prasaja and Khomarun (2017), titled "Comparison Between Neurodevelopmental Treatment (NDT) and the Combination of NDT and Sensory Integration for Improving Standing Balance in Children with Special Needs," published in Jurnal Keterapian Fisik, it was found that the combination of NDT and Sensory Integration was more effective than NDT alone in enhancing standing balance in children with special needs.[14]

According to Moonik (2015), the success of stimulation for enhancing muscle strength is significantly influenced by early detection and early intervention, carried out routinely for more than three weeks. The earlier and more frequent stimulation, the better the muscle development and strength will be. Therefore, it can be concluded that the NDT method is efficacious in improving walking on inclined surfaces in children with Global Developmental Delay (GDD) when applied for the appropriate duration.[15]

The lack of improvement in parachute reflexes may be attributed to the child's developmental health issues, which can impede the development of this reflex and require more time to mature. Similarly, the GMFM measurements did not show significant progress, likely due to insufficient stimulation or practice outside formal therapy sessions. Family involvement and consistency in home exercises are crucial for reinforcing therapy outcomes. Additionally, the duration of the therapy may have been insufficient to produce significant changes. Improving gross motor skills requires time, consistency, and a sustained approach.[16]

This study identifies several limitations, including the short duration of just 3 weeks with four sessions. A more extended study period might yield more significant results and provide a deeper understanding of therapy effectiveness. Extending the research duration could allow for assessing long-term therapy effects and provide more accurate data on patient progress. Furthermore, conducting research with an appropriate control group is recommended, such as comparing patients receiving therapy with a control group not receiving it. This could help researchers evaluate the extent of improvements due to the treatment.

Conclusion

In this case, the Neurodevelopmental Treatment (NDT) method is applied to a 5-year-old patient, An. Rf, diagnosed with global developmental delay and encephalitis, shows that the technique effectively promotes upright standing and improves walking on inclined surfaces. However, the final evaluations revealed no significant improvement in transitioning from sitting to standing for walking and stopping, no enhancement in functional abilities as measured by GMFM, and no emergence of the parachute reflex.

The development of motor skills in children with special needs cannot be achieved through only four therapy sessions. Therapy must be conducted regularly and over an extended period to achieve long-term goals for the child.
It is recommended that readers and anyone with neighbors, relatives, or family members experiencing developmental delays consult medical professionals and seek physiotherapy for appropriate treatment without panic. Therapists should continue the exercise program until the targeted results are achieved, focusing on short-term goals, such as improving the transition from sitting to standing and enhancing the parachute reflex, and long-term goals, such as attaining independent walking and age-appropriate activities.

Acknowledgments and Additional Information

The researcher extends gratitude to all those who supported and contributed to this study and the patient's parents for granting permission and participating willingly. Hopefully, this research will serve as an additional source of valuable information and can be disseminated to the public. Following the treatment, the patient's parents reported that their child improved independent walking ability, reaching a distance of 1 meter.

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