http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v13i09.05

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Research Article

Effectiveness of NDT Approach Combined with PNF for the Treatment of Post-Cord Entanglement Patient – A Single Case Study-Experimental Design

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Abstract
Background: *umbilical cord entanglement raises the chance of protracted labour and unsettling foetal conditions because of compression of the umbilical cord. Wrapping of the cord around foetal tissues is known as umbilical cord entanglement (UCE), and it is the most frequently observed complication of the umbilical cord. Multiple sections of the foetal body make up 6.4% and limb entanglement is 4.2%.The focus of the treatment is on improving the postural and movement components that support functional motor performance and how the function is impacted by sensory awareness. Interventions are given to improve Self-care, eating, and fine and gross motor skills that influence daily abilities and play.*
Material and Methods: *1-year-old boy who had a history of post-umbilical cord entanglement around both legs. His parents sought physiotherapy treatment because they were worried about his learning to walk and his gross motor skills were the main source of his motor issues. Various physiotherapy interventions where given like NDT, PNF. Pre and post evaluation was done by using GROSS MOTOR FUNCTION MEASURE – 88 (GMFM-88)*
Result: *post evaluation there was improvement in GMFM scoring.*
Keywords- *cord entanglement, motor function, gross motor skills.*

Introduction

With an incidence that ranges from 14.7% to 33.7% of all deliveries, umbilical cord entanglement is the most prevalent pathological occurrence among umbilical cord anomalies. According to reports, umbilical cord entanglement raises the chance of protracted labour and unsettling foetal conditions because of compression of the umbilical cord.[1] Wrapping of the chord around foetal tissues is known as umbilical cord entanglement (UCE), and it is the most frequently observed complication of the umbilical cord. Multiple sections of the foetal body make up 6.4% and limb entanglement is 4.2%.[2]

The foetal cardiovascular system is extended into the umbilical cord. The umbilical cord's natural anatomical features protect umbilical vessels, including umbilical veins and arteries. The umbilical cord's length, Wharton's jelly, two arteries, coiling, and general suspension in protecting amniotic fluid—all of which are essential for foetal development—are some of these features. All of these characteristics work together to protect the umbilical cord against compression, shearing, and twisting forces throughout pregnancy, especially during uterine contractions and the foetal descent that follows in the mother's pelvis and birth canal during labour and delivery.[3]

Nuchal cord entanglement, in which the cord is wound around the foetal neck, is the most prevalent kind, however, entanglements with the torso or extremities can also happen. Due to the fact that they are relatively loose, most cord entanglements do not result in negative consequences. After the membrane bursts and the baby descends the delivery canal, some entanglements may get tighter.[4]Neurologic dysfunction and pulmonary hypertension are two gross cord anomalies that have also been linked to late neonatal problems.[5]

Cord entanglement can be categorized based on their placement (neck, body, extremities, or mixed), number of loops (single, double, triple, or many), and nature (tight or loose). A lengthy umbilical cord, monoamniotic multiple pregnancy, or an abundance of amniotic fluid can all contribute to cord entanglements, which are the result of active foetal motion. This results in a reduction of the free segment of cord, the extent of which can be approximated by measuring the segments surrounding the neck (approximately 32 cm in the case of the nuchal cord), the leg (15cm), and the arm (10 cm).Cord entanglement's clinical significance is still up for debate, but given how frequently it occurs, it has to be regarded as a physiological event. Entanglement of the cord is typically not an issue during pregnancy, labour, or delivery. Additionally, meconium-stained amniotic fluid, foetal acidosis, emergency caesarean sections, neonatal intensive care unit (NICU) admissions, and an increase in pathologic monitor tracings have all been linked to cord entanglement.[6]

Encirclements of the umbilical cord happen early in pregnancy. Either by themselves, they hinder foetal growth, or they are a sign of an unidentified harmful stimulation that also stunts growth.[7]

Therapists worldwide frequently employ neurodevelopmental treatment (NDT) to treat children and adults with neurological motor dysfunction, including those with cerebral palsy, spinal cord injuries, traumatic brain injuries, cerebrovascular accidents, or low birthweight children (such as at-risk infants).[8]Giving them as much freedom as possible is the primary goal of the neurodevelopmental treatment method (NDT-Bobath). The prevention of aberrant motor patterns and the promotion of normal motor synergy during daily functional activities are secondary goals of NDT.[9]

The focus of the treatment is on improving the postural and movement components that support functional motor performance and how the function is impacted by sensory awareness. Self-care, eating, and fine and gross motor skills that influence daily abilities and play behaviours are skills that are usually prioritized in treatment.[10]

A stretching method called proprioceptive neuromuscular facilitation (PNF) is used to increase muscle suppleness and has been demonstrated to enhance both active and passive range of motion.[11]

The ICCs for test-retest reliability for dimension scores on the GMFM-88 ranged from 0.94 to 1.00.[12]

Methodology

The study is a quasi-experimental one. Following a thorough explanation of the treatment regimen, research aims, needs, advantages, and potential hazards, parents were asked to complete the informed consent form. Later, the GMFM-88 scale was used to evaluate the subject. He was moved on to the treatment program after the pre-test was finished.

The Arogyam Physiotherapy Clinic received a 1-year-old boy who had a history of post-umbilical cord entanglement around both legs. His parents sought physiotherapy treatment because they were worried about his learning to walk and his gross motor skills were the main source of his motor issues.

His gestation duration was 36 weeks and his birth weight was 2.8kg when he was born. Physicians saw that the baby's vitals were declining, so they conducted an emergency caesarean surgery to deliver the baby. When the infant was delivered, they discovered that the umbilical cord was securely entangled in both lower extremities, with the right side more so than the left.

Fig-1

Fig- 2

Arthrogryposis with bilateral complex club foot, bilateral knee fixed flexion deformity, and left hip dislocation were among his prior medical conditions. When he was 75 days old, he underwent a bilateral surgical tenotomy for that reason. Then at the age of 9 months, he had undergone another operative procedure bilateral tendoachilis tenotomy and 25-degree dorsiflexion was achieved. Plaster cast was then applied with the left ankle in 20–25 degrees of dorsiflexion, the right ankle in 20–25 degrees of dorsiflexion, the right knee in 20–25 degrees of flexion, and the left knee in 90 degrees of flexion.

He next had a left hip capsulotomy, another surgical surgery, when he was 1.5 years old. He recently had surgery at the age of two years old, which included removal of the left proximal femoral implant, right distal femoral extension osteotomy, and bilateral posterior release with tendoachilis lengthening of the ankle.

On Observation

- Patient is in supine position
- Head in midline
- Shoulder levelled
- Bilateral hip in the neutral flexed position
- Bilateral knee in a flexed position (right more than left)
- Bilateral ankle in plantar-flexed position.

On Examination

- Muscle Tone- Normal
- Superficial Tendon Reflexes – Present
- Deep Tendon Reflexes- Normal
- Tightness on B/L Hamstrings and Tendoachilies.
- Passive Range of Motions

S.N.	Movements	Left (ROM)	Right(ROM)
1	Hip Flexion	0-80	0-100
2	Hip Extension	0-15	0-15
3	Hip Abduction	0-45	0-45
4	Knee Flexion	15-120	45-120
5	Ankle Plantarflexion	10-35	16-35
6	Ankle Dorsiflexion	0-10	0-15

ADLs

- Incapable of generating a steady vertical head position.
- Unable to turn their head in a prone position and lift.
- Able to come prone lying position from a supine lying position
- Unable to hold the neck during lifting from supine to sit
- Unable to sit with or without support
- Unable to perform crawling
- Unable to perform kneel standing with or without support
- Unable to stand with or without support
- Unable to walk with or without support

Treatment Given

- He had treatment five times a week for an hour session each time for one year.
- Every therapy session takes place in the patient's house.
- In therapy, home programming and direct physical handling were prioritized.
- Throughout treatment, a range of handling techniques are used, such as the use of toys, therapy benches, and mobile equipment.
- Mostly, the trunk and pelvis were key points of control. Foot proprioceptive input was given directly.
- To encourage appropriate body alignment, reach patterns, and lower limb movements, toys and activities were employed.
- Two methodsof PNF techniques were used for the treatment purpose.
- Contract-relax method (CR) and the contract-relax-antagonist-contract approach (CRAC).

Goal 1: To enhance the lower extremities' graded flexion and extension.

Techniques:

- The pelvis was used as a key point of control to lead the child's movement to squat or reach to the floor and then return to stand while they were standing with their trunk and lower extremities aligned properly. The pelvic control was gradually reduced to start the automatic movement.
- One foot in front of the other and parallel and symmetrical alignment made it easier to squat to stand, giving you more control over your action while putting different strain on your pelvis and lower extremities.
- Reaching between legs for toys on the floor, shifting the weight in the feet and rotating the pelvis, and finally placing the toys on the bench were all practised while in the quadruped posture with hands on various surfaces. Throughout treatment, the quadriceps and pelvis were used as key points of stimulation.

Goal 2: To enhance trunk and pelvic control during transitional motions.

Techniques:

- With the arms extended overhead and the pelvis stretched with the hips abducted, the trunk and pelvis were ready for rotation while the patient lay prone on a therapy ball.
- As the pelvis began to loosen up, lateral weight transfers were added, which rotated the pelvis into a side-lying position and separated it from the trunk.Lateral bending and reclining up to semi-side sitting evoked active trunk motions.
- Reaching behind the body for toys to achieve upper and mid-trunk rotation was encouraged when sitting for extended periods or on a therapy bench. The pelvis was kept in the proper tilt throughout the treatment, and the lower extremities were kept in a posture to lengthen the hamstrings and dorsiflex the feet.
- lowering oneself slowly and gradually from standing to sitting in a chair while stimulating the pelvic rotation.

Goal 3: Activate the hip extensors and ankle plantar flexion with leg dissociation after achieving a full range of motion in the hip flexors, hamstrings, and ankle dorsiflexors.

Techniques:

- The therapist used gentle movements of the hips and ankles to provide a prolonged stretch and deep proprioceptive input into the quadriceps, gastrocnemius, and gluteals through the heels.
- With one foot standing and the other foot on the stools, weight shifts and weight bearing were employed. standing from a half-kneeling position. To avoid knee recurvatum, precautions were taken.

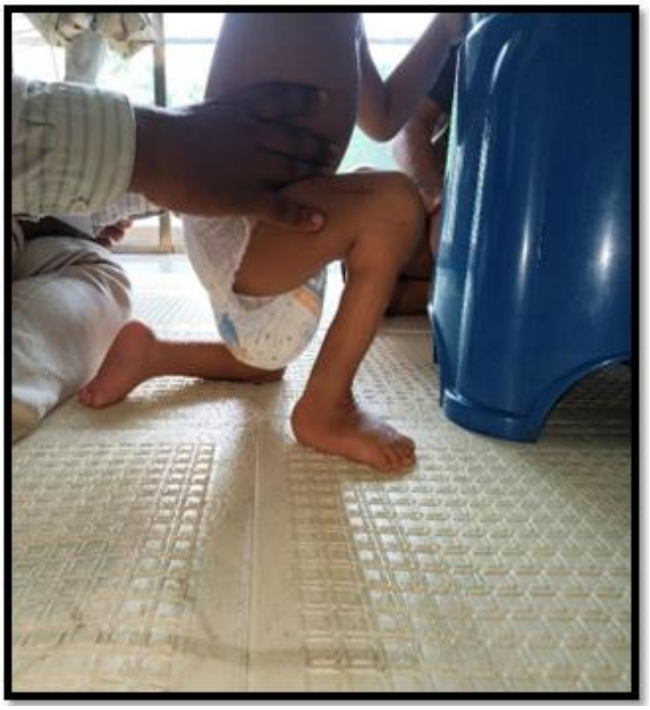


Fig-3

Goal 4: To increase the range of motion in the knees and ankles.

Techniques:

- Two methods of PNF techniques were used for the treatment purpose.
- Contract-relax method (CR) and the contract-relax-antagonist-contract approach (CRAC).The participant contracted the target muscle (TM) to its maximum isometrically for an allotted period while the TM was lengthened and held in that position. This was the CR method.
- The CRAC method was a continuation of the CR method, although it followed the same steps. The participant engaged the antagonist muscle to the TM for an additional designated amount of time rather than merely passively extending the TM.

Fig- 4

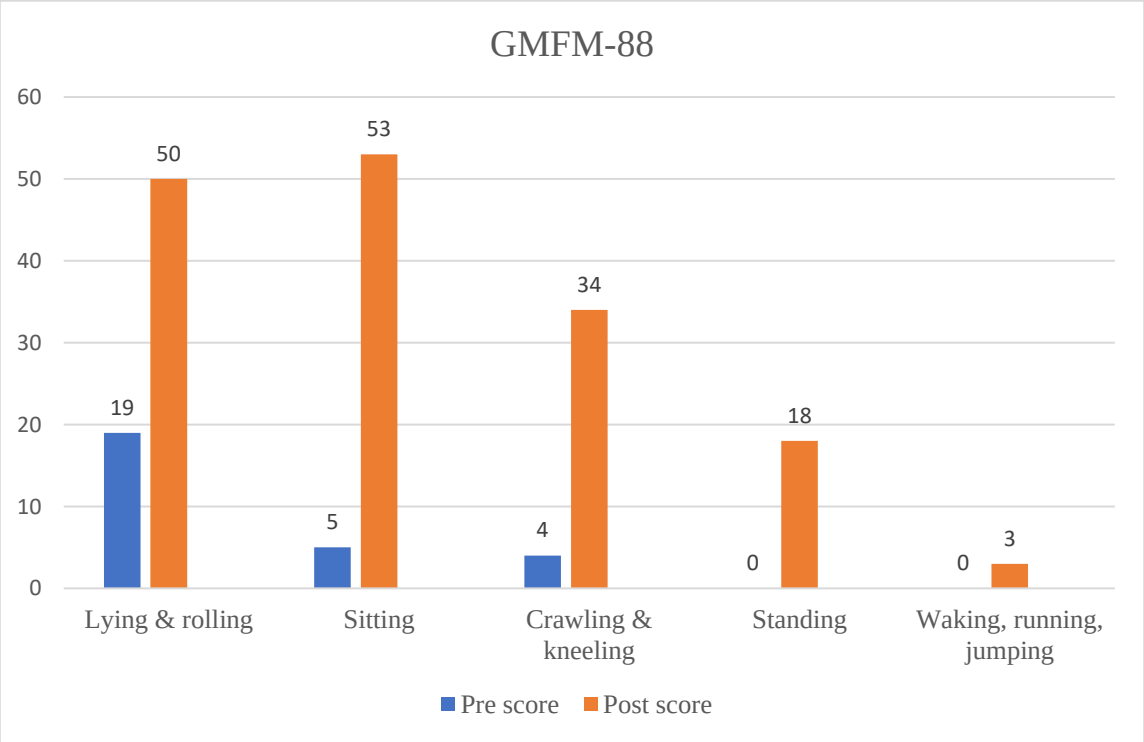
Post-Treatment Evaluation

Table 1 indicates that the Gross Motor Function score increased significantly.

Table-1 Gross Motor Function Measure – 88 (GMFM-88)

S.N.	COMPONENTS	PRE SCORE	POST SCORE
1	Lying & Rolling	19	50
2	Sitting	5	53
3	Crawling & Kneeling	4	34
4	Standing	0	18
5	Walking, Running, Jumping	0	03

Graph-1



Discussion

The purpose of the current study is to determine how NDT and PNF interact with a patient who has experienced cord entanglement. When measured using the Gross Motor Function Measure-88 scale, the post-treatment examination shows a significant improvement in scores compared to the pre-treatment period.

A standardized observational tool called the GMFM was created and approved to track children's changes in gross motor function across time. The overall score on the Gross Motor Function Measure-88 scale is 264.There are five sections and 88 components total. Each component is scored with four points, which are 0, 1, 2, and 3. 0 denotes no initiation, 1 denotes initiation, 2 denotes partial completion, and 3 denotes completion. Section 1, pertaining to lying and rolling, comprises 17 components; Section 2, concerning sitting, consists of 20 components; Section 3, addressing crawling and kneeling, contains 14 components; Section 4, related to standing, includes 13 components; and Section 5, which covers walking, running, and jumping, encompasses 24 components.

As we can see, the score changed, especially in the fourth and fifth sections, which was made possible by improvements in the lower limb joints' range of motion.

To enhance involvement and quality of life, the NDT model views the therapy setting as a means of assisting the client in relearning activities. NDT

induces neuroplastic alterations that facilitate the anatomical, physiological, and behavioural restructuring essential for optimal client functionality.[17]

The brain's ability to reorganize both physically and functionally in response to experience and usage is known as neuroplasticity. Therefore, neuroplasticity can also be understood as a necessary adaptation to every neurobiological process. This would imply that any neurobiological event can alter the structure and function of the brain and, as a result, cause behavioural changes due to neuronal plasticity. The structure and function of the brain change as a result of events that trigger a neurobiological reaction. Thus, when neuroplasticity refers to synaptic alterations caused by the strengthening or weakening of the postsynaptic neuronal response, resulting in modifications to neuronal functional qualities, it can be categorized as functional. The emergence and pruning of axonal and dendritic branches, or even whole neurons, are associated with structural neuroplasticity.[16]

In the PNF intervention technique, excitement is produced by a series of weak stimuli. Excitation is produced when mild stimuli are presented to various body parts at the same time and reinforce one another. Coordinated motion requires reciprocal innervation, which occurs when muscles contract and their antagonists are simultaneously inhibited.[18]

The findings of the study revealed a considerable improvement in Gross motor function comparable to the outcome of Meihua Li et al. (2023), which indicated that NDT intervention can greatly speed the motor development of newborns at high risk of cerebral palsy.[13]

Mandar Malawade and Subhash Khatri's (2017) study, which demonstrated that children with spastic diplegia improve their gait metrics when treated with neurodevelopmental technique (NDT) techniques, similarly corroborated the notable improvement in the current study.[14]

The current study's results showed a significant increase in the range of motion, which was consistent with Débora Wanderley et al.'s (2018) conclusion that PNF is superior to other stretches in enhancing ROM in young, healthy people.[15]

Conclusions

The study concluded that enhancements in gross motor function and range of motion were observed in individuals with post-cord entanglement following physiotherapeutic interventions, specifically NDT paired with PNF stretching. The study's results endorsed the practical implementation of NDT in conjunction with PNF stretching to attain superior outcomes. Consequently, it can be incorporated into the daily physiotherapy treatment regimen to enhance patient outcomes.

Conflicts of Interest

There are no conflicts of interest.

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