Efficacy of Rehabilitation Measures on the Functional Development of Children with Spastic Cerebral Palsy

A. Dinakaran
Professor, Adhiparasakthi College of Physiotherapy,
The TN Dr. MGR Medical University, Guindy,
Chennai, Tamilnadu, India
dinnavillpt@gmail.com

***Abstract*—Background: Spastic cerebral palsy (CP) is the most common type of CP. Up to 80% of all Individuals with cerebral palsy suffer from some degree of spasticity. Spasticity adversely affects muscles and joints of the extremities, causing abnormal movements, and it is especially harmful in growing children.**

Cerebral palsy (CP) is a syndrome of motor impairment that results from a lesion occurring in the developing brain. The degree of spasticity can vary from mild muscle stiffness to severe, painful, and uncontrollable muscle spasms .Normally; muscles must have enough tone to maintain posture or movement against the force of gravity while at the same time providing flexibility and speed of movement.

Spasticity is a velocity-dependent increase in resistance of a muscle when the muscle is moved passively or stretched. Individuals with spastic CP experience stiffness in affected limbs due to focal muscular hyperactivity, resulting in limited or awkward movements.

In this research work Quasi experimental design was adopted for Pre- assessment of physical and functional status of children with cerebral palsy assessed by appropriate tools and the results discussed in detailed in different sections of the paper.

Key words: cerebral palsy, children, spasticity, assessment, treatment

I. Introduction

Spastic cerebral palsy (CP) is the most common type of CP. Up to 80% of all individuals with cerebral palsy suffers from some degree of spasticity. Spasticity adversely affects muscles and joints of the extremities, causing abnormal movements, and it is especially harmful in growing children. [9]

Cerebral palsy (CP) is a syndrome of motor impairment that results from a lesion occurring in the developing brain. The disorder varies in the timing of the lesion; the clinical presentation depends upon the site and severity of the brain Parenchyma suffers the insult such loss of oxygen and nutrition to the specific neurons in the brain.[6]

Neuroplastic changes following any acquired brain injury will result in subsequent neuronal cell death, interruption of their axonal projections and potential cascade of degeneration to communicating neurons. The impact the lesion has on motor control and function will depend upon the location and the size of the lesion.[8]

TABLE 1.The causes for the lesion occurring in brain

Pre-natal causes	***Peri-natal causes***	***Post natal causes***
Consanguineous marriage	Birth asphyxia	Meningitis
Rh- incompatibility	Prolonged labor	Delayed birth cry
Frequent abortion, age of mother (<18/>35),	Forceps delivery	Lack of immunization
Viral infection during pregnancy	Me conium aspiration, hypoglycemia of mother	Seizures of child
Hypertension, diabetes & malnutrition of pregnant women, intake of some drugs	Umbilical cord around the neck,	Injury
Accidents, exposure to radiation, multiple pregnancies and underweight of mother during pregnancy serve as the causes of cerebral palsy.	Breech delivery ,pre-term delivery, low birth weight	Accident
Multiple pregnancies and underweight of mother during pregnancy	Neo-natal jaundice, neo natal seizures	Malnutrition
	Reduced amniotic fluid of mother and bluish discolorations of skin.	

Spastic CP is the most common type of CP. Up to 80% of all individuals with cerebral palsy suffers from some degree of spasticity. The degree of spasticity can vary from mild muscle stiffness to severe, painful, and uncontrollable muscle spasms [7]

Spasticity is a velocity-dependent increase in resistance of a muscle when the muscle is moved passively or stretched. Individuals with spastic CP experience stiffness in affected limbs due to focal muscular hyperactivity, resulting in limited or awkward movements. Spasticity refers to increased tone, or tension, in a muscle.

Normally, muscles must have enough tone to maintain posture or movement against the force of gravity while at the same time providing flexibility and speed of movement. The command to tense, or increase muscle tone, goes to the spinal cord via nerves from the muscle itself. Since these nerves tell the spinal cord just how much tone the muscle has, they are called "sensory nerve fibers."The command to be flexible, or reduce muscle tone, comes to the spinal cord from nerves in the brain. These two commands must be well coordinated in the spinal cord for muscles to work smoothly and easily while maintaining strength.

In a person with CP there is the damage in the brain which is usually in the area of the brain that controls muscle tone and movement of limbs. Therefore, the brain is unable to influence the amount of flexibility a muscle should have. The command from the muscle itself dominates the spinal cord and, as a result, the muscle is too tense or spastic.[1]

II. EFFECTS OF SPASTICITY

Spasticity adversely affects muscles and joints of the extremities, causing abnormal movements, and it is especially harmful in growing children.

The known adverse effects of spasticity include:

1. Inhibition of movement
2. Inhibition of longitudinal muscle growth
3. Inhibition of protein synthesis in muscle cells
4. Limited stretching of muscles in daily activities
5. Development of muscle and joint deformities

Spasticity may affect any muscle group in the body; however, there are some common patterns that are seen in cerebral palsy.

Effect on the upper limbs: flexion at the elbow, wrist and fingers.

Effect on the lower limbs: flexion at the hip, adduction or 'scissoring' of the thighs, flexion at the knees, equinovarus foot posture, hyperextension of the big toe.

Spasticity can also be present in smaller muscles such as tongue and facial muscles.

Although the damage to the brain that causes spasticity does not change over time, the effects of spasticity on the body can result in changes. [10]

Effects of spasticity over time:

• Changes in soft tissues (muscles, tendons and ligaments) leading to muscle stiffness, atrophy and fibrosis.

• Muscles that are affected by spasticity have difficulty stretching out to keep up with bone growth - resulting in muscles that are shorter than they should be. This prevents a joint achieving its normal full range of movement - a contracture.

• Shortened, contracted muscles can pull on the bony structures of the body leading to bone deformities such as scoliosis of the spine and hip dislocation.

• Pain - persistent over activity in spastic muscles can cause pain in the muscle. Pain can also occur as a result of changes in the joint position and deformities due to the abnormal pull of the spastic muscle.[12]

CLINICAL ASSESSMENT OF SPASTICITY

Several methods have been developed and used to assess spasticity. The most commonly used test in clinical practice is the Modified Ashworth Scale (MAS).

The test is based on the assessment of resistance to passive stretch of muscle group at one non specified velocity.

TREATMENT OF SPASTIC CEREBRALPALSY

CP rehabilitation programs for children utilize a multidisciplinary approach where members of a team are selected with respect to a child's age, developmental level, severity of impairment, and availability of services. Yet, in all cases, the child's family remains at the center of the treatment team and a child's challenges can be a great source of stress to the family that may impact quality of life.[4]

Management of spasticity in CP involves multidisciplinary intervention intended to increase functionality, sustain health, and improve quality of life for children and their careers. This may include: oral medications, intrathecal medications, physiotherapy, occupational therapy, orthoses, surgical interventions, and pharmacological agents such as botulinum toxin.

- Medications that can lessen the tightness of muscles may be used to improve functional abilities
- Orthopaedic surgery is used to lessen muscle tightness or correct bone abnormalities caused by spasticity.
- *Conventional rehabilitation.* Stretching forms are the basis of conventional rehabilitation for treating spasticity. Stretching helps to maintain the range of motion in joint and helps prevent contracture. To be effective, the prescribed stretching routine must be done regularly, usually once or twice a day.
- *Facilitation.* This includes neurodevelopmental therapy (also known as Bobath approach) aimed at reducing inappropriate reflexes and training muscles to achieve normal balanced reactions. Proprioceptive neuromuscular facilitation seeks to retrain spastic muscles for normal motion. Sensory integration involves continually repeating tasks, often with the therapist directing the limb while child remains passive, so that child`s brain is "retrained" in the proper movements.[3]
- *Hydrotherapy.* Aquatic exercise programme may be useful for improving gross motor functioning, for reducing spasticity and for increasing cardio respiratory endurance in children with spastic CP.
- *Orthoses.* Also known as casts, braces, or splints, orthoses include any device that is used to support, align, prevent, or correct deformities, or improve the function of movable parts of the body. When used to

treat spasticity, orthoses may reduce muscle tone and increase or maintain motion

How bobath concept works out neural plasticity

Neuroplasticity-The plasticity of a structure is its ability to show modification or change. Motor learning is the permanent change in an individual's motor performance brought about as a result of practice. The structures undergoing modification which need to be considered during motor learning are neural plasticity and muscular plasticity.

The capacity of the nervous system to change is demonstrated in children during the development of neural circuits, and in the adult brain, during the learning of new skills, establishment of new memories, and by responding to injury throughout life. The nervous system and neuromuscular system can adapt and change their structural organization in response to both intrinsic and extrinsic information.
There include

- Recruitment of latest synapses
- Synoptic potentiation
- Recovery of synoptic functions
- Axonal sprouting
- Formation of new synaptic connection
- Formation of dentritic spines.

NDT is a non-Invasive program me of movements which aims to promote development of the nervous system and the inhibition of primitive reflexes.

By incorporating movements which are used naturally by a baby and young child, the nervous system is gently encouraged to mature and become more open to learning.
During the therapy, child will have a set of specific movements which are performed every day for approximately 5-10 min. Each program me is specifically designed for the needs of each child and will evolve as the program me progresses. Both parents and child are guided by therapist through the full program me and she he will review progress with you both at regular intervals.

A complete program me generally last far between 12-18 months.

Dr and Mrs. Bo bath describe NDT as a "living concept". NDT approach is not a set of techniques but more an understanding of the developmental process of a motor control and the motor component which make up functional motor task.[2]

Treatment sessions are goal directed towards a functional task. The process by which this is achieved includes child- initiated movement and task. The therapist will do preparatory work (e.g. Muscle elongation) to enable the child perform the task and may initially facilitate and guide the movements as needed to decrease are prevent abnormal compensatory movements.

Feed forward is developed as the child actually practice the skill or task with the therapist guidance
The manipulation of this information can directly affect a change in the structural organization of the nervous system through spatial and temporal summation and the facilitation of pre- and post-synaptic inhibition. Motor learning refers to the permanent change in an individual's motor performance brought about as a result of practice or intervention.
There are several physiological mechanisms by which neuro plastic adaptations can occur in healthy individuals and after lesions to the central nervous system.[11]

Motor learning principles help identify how we can best manipulate the individual, the task and the environment to influence long-term neuroplastic changes to promote an individual's motor performance.
The Karel Bo bath Concept is goal orientated and task specific , and seeks to alter and construct both the internal (proprioceptive) and external (exteroceptive) environmental which the nervous system and therefore the individual can function efficiently and effectively .

Treatment is an interaction between therapist and patient where facilitation leads to improved function. The role of the therapist is to both teach movements and make movement possible by utilizing the environment and the task appropriately. Treatment is aimed at improving the efficiency of the movement compensation following an UMN lesion.
Rehabilitation is a process of learning to regain motor control and should not be the promotion of compensation that can occur naturally as a result of a lesion

Problems with NDT

- Impossible to diagnose cerebral palsy under the age of 4months and even under 6-8months in slightly affected case with soft neurological signs.
- Diagnoses of type of cp is even more so[13]

Advantage with NDT

Early treatment at around 3-4months of age is important because of the great adaptability and plasticity of the infantile brain. During the 1st 18teen months of the Childs life there is great and speedy development and at no others stage of growth does the child learn so quickly.[5]

III. RESEARCH METHODOLOGY

Statement of the Study

"Efficacy of rehabilitation measures on the functional development of children with cerebral palsy"

Aim of Study

- To enhance the physical development of children with cerebral palsy
- To improve self-care and improve academic and communication skills of children with cerebral palsy
- To train the children to acquire vocational skills.
- To reduce the emotional burden of parents through counseling services.

Need for Study

- Support the development of multiple systems such as cognitive, visual, sensory and musculo skeletal.
- Involve play activities to ensure compliance
- Enhance social Integration
- Involve the family
- Have fun.

Ethical Clearance

- Once the study was approved ethical clearance obtained from
- The Melmaruvathur Adhiparasakthi Institute Of Medical Sciences- Ethical committee

Research design

The research design adopted for the present study is quasi experimental research design. The study does not include control group and randomization of samples. Pre assessment of physical and functional status of children with cerebral palsy will be assessed by appropriate tools. Specific rehabilitation services will be carried out. Post assessment will be done at every 3 months for a period of 01 years.

Study Setting - Adhiparasakthi Annai Illam –Melmaruvathur

Duration of Study - Period of 3 years

Population - Spastic Cerebral Palsy Childern Within 2-10 Yrs of Age

TABLE II. SAMPLING CRITERIA

Inclusion criteria: -	**Exclusive criteria:-**
Spastic Diplegic,	Above age 10
Spastic Hemiplegic	Respiratory problems
Spastic quadriplegic	Epileptic seizures
Spastic monoplegic	Dysphagia
Athetoid	Depression
Quadriplegia ataxia	Gastro esophageal reflux
2-10 year's age	Sleep Disorder
	Visual& hearing disorder
	Mental retardation
	Cortical sensory deficits.
	Communication deficiency
	Under went surgical procedures Such as tendon lengthening

Sampling method and sampling size: Convenient sampling technique is adopted based on inclusion criteria Sample size is 120 subjects,05 samples were dropped for various reason

Variables:
Independent variable – Neuro developmental therapy
Dependent variable - Measured by gmfm scale -66

Measurement tools:

Gross motor functional classification system for cerebral palsy (GMFMS -66)
Modified Ash worth scale for grading spasticity
Pediatric therapy Assessment chart

Techniques of treatment:

Therapeutic techniques especially Neuro-developmental therapy were given, sensory integration therapy, and Rood' therapy were applied according to the need. Apart from the physiotherapy techniques special education training were given. Special education training improve the

1. Activities of daily living
2. Cognition.
3. Concept learning
4. Academic skills
5. Language
6. Community orientation
7. Socialization and
8. Domestic activities.

According to the need prevocational and vocational training were also be given. Counseling services were provided to the parents of children to handle the children properly. Records of techniques applied to each child maintained.

Data Collection

- Samples were collected till March 2013. A child selected for study treated by neuro developmental therapy technique for about one year from date of inclusion of study.
- Its functional development is assessed by using GMFM 66 at the time of inclusion in study and at every 3 months for about one year, periodically 04 levels of assessment done using GMFM-66 scale for a sample during one year of study period.
- Out of 120 samples 05 samples were dropped out due to various reasons and the sample Chart attached

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Adhiparasakthi college of physiotherapy-Adhiparasakthi Annai illam(center for special children)
Melmaruvathur

SI. NO	CLIENT ID	AGE	DIAGNOSIS	DATE OF INCLUSION IN THE STUDY	INTIAL SCORE AT INCLUSION	Ist ASSESSMENT DATE	Ist ASSESSMENT SCORE	IInd ASSESSMENT DATE	IInd ASSESSMENT SCORE	IIIrd ASSESSMENT DATE	IIIrd ASSESSMENT SCORE	IVth ASSESSMENT DATE	IVth ASSESSMENT SCORE
1	1	7/M	SPASTIC QUADRIPLEGIC CP	5-Jun-11	14.83	6-Sep-2011	39.73	6-Dec-2011	46.91	7-Mar-2012	57.33	7-Jun-2012	62.09
2	17	6 /F	SPASTIC HEMIPLEGIC CP (RT)	8-Jun-11	28.02	8-Sep-2011	38.96	8-Dec-2011	43.61	8-Mar-2012	52.32	8-Jun-2012	57.56
3	51	4 1/M	SPASTIC QUADRIPLEGIC CP	18-Jun-11	20.54	19-Sep-2011	20.54	19-Dec-2011	20.54	19-Mar-2012	21.25	19-Jun-2012	21.25
4	40	8 2 /M	SPASTIC DIPLEGIC CP	21-Jun-11	50.62	21-Sep-2011	53.09	21-Dec-2011	57.62	21-Mar-2012	64.98	21-Jun-2012	70.81
5	35	6 M /M	SPASTIC QUADRIPLEGIC CP	27-Jun-11	8.12	27-Sep-2011	20.54	27-Dec-2011	28.66	27-Mar-2012	34.37	27-Jun-2012	36.02
6	22	5 /M	SPASTIC HEMIPLGIC CP(RT)	7-Jul-11	68.86	7-Oct-2011	69.63	7-Jan-2012	69.22	7-Apr-2012	79.99	7-Jul-2012	85.23
7	27	7 /M	HYPOTONIC CP	7-Jul-11	23.37	7-Oct-2011	43.79	7-Jan-2012	50.09	7-Apr-2012	70.39	7-Jul-2012	70.39
8	42	1 8 /M	SPASTIC QUADRIPLEGIC CP	9-Jul-11	0	9-Oct-2011	10.42	9-Jan-2012	14.83	9-Apr-2012	18.01	9-Jul-2012	19.72
9	43	2 1/2 /M	SPASTIC HEMIPLEGIC CP (RT)	13-Jul-11	55.92	13-Oct-2011	57.86	13-Jan-2012	61.21	13-Apr-2012	73.1	13-Jul-2012	80.93
10	26	9 M /M	SPASTIC QUADRIPLEGIC CP	16-Jul-11	24.01	16-Oct-2011	37.43	16-Jan-2012	42.85	16-Apr-2012	50.62	16-Jul-2012	53.09
11	9	5 1/2 / F	SPASTIC DIPLEGIC CP	18-Jul-11	35.26	18-Oct-2011	36.79	18-Jan-2012	40.2	18-Apr-2012	46.5	18-Jul-2012	48.09
12	16	7 /F	SPASTIC QUADRIPLEGIC CP	10-Aug-11	43.61	10-Nov-2011	44.79	10-Feb-2012	47.5	10-May-2012	54.91	10-Aug-2012	56.86
13	44	1 / M	SPASTIC QUADRIPLEGIC CP	17-Aug-11	0	17-Nov-2011	12.12	17-Feb-2012	18.89	17-May-2012	24.66	17-Aug-2012	25.31
14	31	2 4 /F	HYPOTONIC CP	20-Aug-11	20.54	20-Nov-2011	44.03	20-Feb-2012	50.32	20-May-2012	76.04	20-Aug-2021	80.93

IV. CONCLUSION

Data were analyzed by using descriptive statistics and inferential statistical methods. The outcome result shows that the neuro developmental therapy play effective role in neural plasticity. The spasticity grading was done using Modified Ash worth scale but not analyzed .The study must be extended be compared with other available technique to prove the effectiveness of neurodevelopmental therapy.

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