Overview of Physical Therapy for Children with Cerebral Palsy

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Purpose Review of the evidence on the effectiveness of NDT/Bobath therapy and alternative treatments for children and adolescents with cerebral palsy to inform LHB commissioning decisions for this treatment.

Method The electronic journal site was searched by terms "cerebral palsy", "intervention", physical therapy". We analyzed and descript the total 24 cited articles from 9 articles in Science Direct, and 16 articles in K- RISS from 20 Oct. 2018 to 7 Jan. 2019.

Results Later definition of cerebral palsy emphasized secondary musculoskeletal problem over time in children with cerebral palsy. In early definition emphasized person's function or neurological disability. Prevalence rate of cerebral palsy were 6~8% from perinatal asphyxia, the overall prevalence of cerebral palsy has remained constant in recent years despite increased survival of at-risk preterm infants. Gross Motor Function Classification System (GMFCS) has been widely employed internationally to group individuals with cerebral palsy into one of five levels based on functional mobility or activity limitation. The treatment must be goal oriented, such as to assist with mobility, reduce or prevent contractures, improve positioning and hygiene, and provided comfort. Each member of the child's multidisciplinary team, including the child and both parents, should participate in the serial evaluation and treatment planning.

Conclusion We found that the definition of cerebral palsy is changing to focus on secondary problem over time and the children with cerebral palsy is best cared for with an individualized treatment plan that provides a combination of interventions.

Keyword Cerebral Palsy, Intervention, physical therapy

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I. Instruction

Cerebral palsy was described in 1862 by an orthopedic surgeon, William James Little first, a motor disorder resulting from a non-progressive insult to the developing brain (Shevell & Bodensteiner, 2004). Children with cerebral palsy suffer from multiple problems and potential disabilities such as mental retardation, epilepsy, feeding difficulties, and ophthalmologic and hearing impairment.

Dzienkowski et al (1996) recommended the primary health care practitioner must be prepared to recognize neuro-motor deficits, diagnose and classify the type of disorder, and implement a methodical treatment plan. Early institution of physical, occupational, and speech therapies

are essential for proper developmental progress (Nygraad et al, 1991).
Physical therapy plays a central role in managing the children with cerebral palsy and it focuses on function, active movement, and optimal use of the child's potential (Caspersen et al, 1985). Physical therapy uses physical approaches to promote, maintain, and restore physical, psychological, and social well-being (Bobath, 1971).
The best care for the children with cerebral palsy is an individualized treatment plan that can provide a combination of intervention (Jan, 2006). Therapeutic intervention included formulating an individualized treatment plan that is functional, goal-oriented, time-limited, and cost-effective. This treatment plan should be team delivered and hospital-home-rehabilitation center-based according to the needs of each child (Horn, 1997).
In the last decade, the evidence based treatment of cerebral palsy has rapidly expanded, providing clinicians and families with the possibility of newer, safe, and more effective interventions (Novak et al, 2013). Sakzewski et al (2009) found that Orthopaedic surgery and movement normalization were once the mainstays of intervention, but localized anti-spasticity medications and motor learning intervention have gained increased popularity.
The intervention for children with cerebral palsy strongly require the provision of a number of family-centered services that make a difference in the lives of these children and their families (Jan, 2006). Setting realistic goals, determination of the priorities, informing the family and enhancing family participation in physical therapy programs will increase the success of physical therapy (Gunel, 2009).
The purpose of this study is to find out proper concept and intervention to treat children with cerebral palsy in physical therapist's perspective according to recognize the changing definition of cerebral palsy, and to investigate the several classification and intervention for children with cerebral palsy.

II. **Method**

The electronic journal site was searched by the search terms "cerebral palsy", "intervention", we analyzed and descript the total 24 cited articles from 9 articles in Science Direct, and 16 articles in K- RISS.

III. **Results**

1. The change of definition of cerebral palsy.

In 1964 cerebral palsy is defined as that a disorder of movement and posture due to a defect or lesion of the immature brain. And the disorder of cerebral palsy was mainly focused on posture and movement (Bax, 1964). A clinical presentation of wide variety of cerebral cortical or sub cortical insults occurring during the first year of life.
Rosenbaum et al (2000) defined the cerebral palsy that a group of permanent disorder of the development of movement and posture causing activity limitation, that are attributed to non-progressive disturbance that occurred in the developing fetal or infant brain.
Rosenbaum et al (2007) modified the definition of cerebral palsy as that the motor disorders of cerebral palsy are often accompanied by disturbance of sensation, cognition, communication, perception, behavior, by a epilepsy and by secondary musculoskeletal problems.
Later definition of cerebral palsy emphasized secondary musculoskeletal problem over time in children with cerebral palsy. In early definition emphasized person's function or neurological

disability.

2. Etiology and prevalence of cerebral palsy.

Originally cerebral palsy was largely attributed to acute hypoxia during labor or birth, but now evidence indicates that most lesions occur in the second half of gestation, an active period of brain development (Hadders-Algra, 2000).

Current evidence suggests that a multiplicity of risk factors contribute to cerebral palsy rather than a single event. Single events such as uterine rupture, cord prolapse, major placental abruption resulting in hypoxic insults to the brain account for a small proportion. Birth asphyxia is not a common antecedent (Nelson, 2008).

According Jan (2006) describe, preterm infants are at the highest risk for developing cerebral palsy. The vulnerable brain is harmed during a critical period of development primarily by known CNS complications of prematurity such as intraventricular hemorrhage and periventricular leukomalacia.

Children with cerebral palsy prevalence increases with lower birthweight and higher immaturity. Increase of survival after preterm birth has first also increased cerebral palsy rates. In the 1980s, this trend was reversed for lower birth weight infants, and in the 1990s, for very lower birth weight or very immature infants (Krageloh-Mann, 2009).

The study from 2006 to 2007 by Oh(2007) in Korea presented that the cause of cerebral palsy in thought to be multifactorial including prematurity, inflammation, genetic cause and environmental factor. Although evidence suggested that 70~80% of cerebral palsy is due to prenatal factors and birth asphyxia palsy a relatively minor role.

In the study of Korea, Cheon (2014) presented that the risk factor for major neurodevelopmental impairments in very lower birth weight infants was related on preterm birth and minimizing hypotension shock and severe IVH.

Prevalence rate of cerebral palsy were 6~8% from perinatal asphyxia (Blair and Stanly, 1988), the overall prevalence of cerebral palsy has remained constant in recent years despite increased survival of at-risk preterm infants (Oskoui et al, 2013).

3. Classification of cerebral palsy

1) Classification by neurological condition (Table 1)

The neurological condition could be assessed by tone abnormality, as well as the diagnosed movement disorder present such as spasticity, ataxia, dystonia, athetosis. The type of abnormal muscle tone or involuntary movement disorder observed or elicited is usually assumed to be related to the underlying pathophysiology of the disorder, and may also reflect etiologic circumstance (Rosenbaum et al, 2007)..

The SCPE (Surveillance of Cerebral Palsy in Europe) classified cerebral palsy into two subtype between spastic and dyskinetic type. This classification of subtype requires an assessment of the predominant motor disorder. It proposed that children continue to be classified by the predominant type of tone or movement abnormality, but any additional tone or movement abnormalities present should be listed as secondary type.

Table 1. Classification of Cerebral Palsy

AACP (Minear, 1956)	Bobath (1997)	AACPDM (1997)	SCPE (2008)
Spastic	Spastic	Spastic	Spastic
Athetosis	Severe	Dyskinetic	Dyskinetic

tension non tension dystonic tremor Rigidity Ataxia Tremor Atonic Mixed Unclassified	moderate Athetosis with spasticity with tonic spasm with intermittent spasm choreoathetosis Ataxia Hypotonia	Hypotonic Ataxic Mixed	dystonic choreoathetosis nonclassibiable Ataxic Non classifiable

AACP : American Academy of Cerebral Palsy
AACPDM : American Academy of Cerebral Palsy and Developmental Medicine
SCPE : Surveillance of Cerebral Palsy in Europe.

2) Classification by topographic of motor involvement.

Cerebral palsy can be classified according to the topographic distribution of motor involvement. Motor deficits include monoplegia, diplegia, hemiplegia, triplegia, quadriplegia and double hemiplegia(Jan, 2006). Monoplegia involved one limb, hemiplegia that lateralized one-half of the body is affected. Triplegia involved 3 extremities, usually both legs and one arm. They may represent hemiplegia plus paraplegia or incomplete quadriplegia. Quadriplegia or Tetraplegia involved all 4 extremities. Diplegia is paralysis affecting like parts on either side of the body in bilateral paralysis. Double hemiplegia also is seldom term and implies those cases in which the arms are more involved than the legs (Minear, 1954); .

According SCPE guideline, any additional tone or movement abnormalities present should be listed as secondary types, as well as the anatomical distribution or topographic of feature like as bilateral, unilateral. The SCPE classification of subtype proposed that spastic bilateral, spastic unilateral, dyskinetic dystonic, dyskinetic choreoathetotic, dyskinetic non-classifiable., ataxic, non classifiable.

3) Classification by functional level

The functional consequences of involvement of the upper and lower extremities should there for be separately classified using objective functional scales. Gross Motor Function Classification System (GMFCS) has been widely employed internationally to group individuals with cerebral palsy into one of five levels based on functional mobility or activity limitation (Beckung & Hagerg, 2002).

The GMFCS was developed for children with cerebral palsy who are 12 years of age and younger and subsequently expanded to include a 12 to 18 year age band revised to include environmental and personal considerations for the 6 to 12 year and 12 to 18 year bands (Palisano et al, 2008).(Table 2).

The GMFCS is a 5 level classification system that describes the gross motor function of children and youth with cerebral palsy on the basis of their self-initiated movement with particular emphasis on sitting, walking, and wheeled mobility. The GMFCS measures what children do in their typical settings (performance), not what they are able to do in an ideal environment (capability). The GMFCS is one of the most widely used classification systems for individuals with cerebral palsy, as it is used in clinical examinations, research, and population based studies (Palisano et al, 2007).

The Manual Ability Classification System (MACS) has been developed to classify how children with cerebral palsy use their hands when handling objects in daily activities. The classification

is designed to reflect the child’s typical manual performance, not the child’s maximal capacity. It classifieds the collaborative use of hands together (Eliasson et al, 2006)

The MACS is a five level system to classify hand use of children with cerebral palsy 4 to 18 years of age. Classification is based on the child’s typical performance in handling objects during daily activities. Distinctions among the levels are based on the child’s ability to handle objects and the amount of assistance or adaptation the child needs to complete tasks of daily living (Eliasson et al, 2006).

Table 2. GMFCS between 12 and 18 birthday : Descriptors(Palisano et al, 2008)

Level	Description
GMFCS Level 1	Youth walk at home, school, outdoors and in the community. Youth are able to climb curbs and stairs without physical assistance or a railing. They perform gross motor skills such as running and jumping but speed, balance and coordination are limited.
GMFCS Level 2	Youth walk in most settings but environmental factors and personal choice influence mobility choices. At school or work they may require a hand held mobility device for safety and climb stairs holding onto a railing. Outdoors and in the community youth may use wheeled mobility when traveling long distances.
GMFCS Level 3	Youth are capable of walking using a hand held mobility device. Youth may climb stairs holding onto a railing with supervision or assistance. At school they may self -propel a manual wheelchair or use powered mobility. Outdoors and in the community youth are transported in a wheelchair or use powered mobility
GMFCS Level 4	Youth use wheeled mobility in most settings. Physical assistance of 1-2 people is required for transfers. Indoors, youth may walk short distances with physical assistance, use wheeled mobility or a body support walker when positioned. They may operate a powered chair, otherwise are transported in a manual wheelchair.
GMFCS Level 5	Youth are transported in a manual wheelchair in all settings. Youth are limited in their ability to maintain antigravity head and trunk postures and control leg and arm movements. Self-mobility is severely limited, even with the use of assistive technology

4. Intervention for cerebral palsy

1) Medical management

Botulinum toxin A injections are being used more frequently to treat upper and lower extremity spasticity and hypertonia in children with cerebral palsy.

Management of spasticity is a major challenge to the rehabilitation team. The initial management has centered on the elimination of externally exacerbating causes, physical therapy, splinting and casting. Medical management has centered on anti-spasticity medication use, but more recently focal treatment methods including phenol blocks and botulinum toxin have been utilized. There has been an increased use of intrathecal baclofen in the management of refractory tone. Dorsal rhizotomy has been advocated for a selective population of children with spasticity. There is no standardized approach to spasticity management and this paper will discuss the importance of evidence-based

treatment of spasticity that is adapted for the individual child(Matthews & Balaban, 2009).

Botulinum toxin type A(BTX), a neuromuscular blocking agent, reduced muscle tone in various neuromuscular disorders. The safety and short term efficacy of BTX injections were evaluated in a prospective, 3 months, double blind, randomized clinical trial involving 114 children with cerebral palsy and dynamic equinus foot deformity. Outcome was determined by observational gait analysis, ankle range of motion measurements and quantification of muscle denervation by nerve conduction. Patients in the BTX group demonstrated improved gait function and partial denervation of the injected muscle (Koman et al, 2000).

Three drugs diazepam, dantrolene and baclofen have been commonly used to alleviate spasticity in cerebral palsy; and debate remains about their usefulness and there is a Cochrane protocol to assess the absolute, and comparative, efficacy of baclofen, dantrolene and diazepam for spasticity in cerebral palsy. Intrathecal baclofen, a much more invasive treatment has been recently introduced and a separate Cochrane protocol will review the evidence for the effectiveness of intrathecal baclofen (Webb, 2008; Howard, 2000).

A surgical method to reduce spasticity by selective posterior nerve root division was first described in 1913 and reintroduced in the 1970s. Numerous studies with confounding, selection bias, lack of controls and use of variable surgical techniques, and application of subjective outcome measures have reported good results leading to the widespread use of this technique. The absence of good evidence to support its efficacy and the lack of information about safety and long term consequences has led to some controversy and the role of this technique, which is expensive and very demanding of the child, family, surgeon and therapist, needs to be justified. There is a Cochrane protocol designed to determine the effectiveness of selective dorsal rhizotomy in the management of children with spastic cerebral palsy (Webb, 2008; Narayanan & Howard, 2001). .

2) Physical therapy for children with cerebral palsy

An 8 month, standardized, functionally based on exercise program significantly improved physical fitness, the intensity of activities and Health Related Quality of Life (HRQOL) in children with cerebral palsy when added to standard care. From an evaluation of the available data it appears that children and adolescents with cerebral palsy may benefit from exercise programs that focus on lower extremity muscle strength and/or cardiovascular fitness (Verschuren, 2007).

Han et al(2018) presents that cranio-cervical flexion based trunk stabilization exercise for 20 minutes a day, 2 times per week total 8 weeks increased significant on Modified Ashworth Scale (MAS), Pediatric Reach Test (PRT) and Trunk Control Measurement Scale (TCMS). The cranio-cervical flexion exercise included chin pull, flexion of head and neck, abdominal throwing exercise, bridging exercise.

In 2012, Choi et al(2012) study showed that trunk muscle strengthening exercise for 3 times per week, total 6 weeks were effective in improving the balance performance of sitting posture for the children with spastic diplegic cerebral palsy without changing muscle tone. The trunk muscle strengthening exercise consisted of 2 exercises to strengthen abdominal muscles and back muscles.

Muscle strengthening exercise with Thera band were effective on balance and gait for children

with cerebral palsy(Lee et al, 2009). This single subject designed(3 participations) study presented that muscle strengthening exercise for 3 times per week total 8 week improved subjects gross motor function, balance ability, gait ability.

3) Neurodevelopmental intervention

Webb(2008) presented that there was a lack of evidence to support the efficacy of any particular physical therapy and that it was difficult to establish the advantages of one particular therapeutic method over another.

Palmer et al(1988) suggested that he group that received program of infant stimulation followed by NDT progressed more quickly (measured using the Griffiths Development Test) than the group who received NDT alone. There was no significant differences between the group in the incidence of contractures, or the need for orthopaedic intervention. The result emphasizes the importance of measuring outcomes other than locomotion and inputs from local services (Palmer et al, 1988).

Law et al(1997) found no benefit of intensive NDT, but Bower et al(2001) found that there was a non- significant trend for benefit for the intensive group when additional covariates of age and severity were introduced, not in the primary analysis and the effect was short lived.

4) Alternative intervention

Acupuncture has been used to treat children and adolescents with CP for more than 20 years. Benefits claimed for acupuncture have included warmer extremities, a decrease in painful spasms, improvement in the use of arms or legs, more restful sleep, improvement in mood and better bowel function(Webb, 2008)

Lu et al(2017) presents the study which the effect of scalp acupuncture on the treatment of children with cerebral palsy in America. Thirty-six children with cerebral palsy were treated with Chinese scalp acupuncture on motor and sensory are, motor area, speech 1, 2 area, balance area, vision area, apraxia area, 1 vision area. These children received between 3~20 treatment, 5 children complete resolution of their symptom, 14 cases a marked effect, 14 had some effect, 3 patients experienced no improvement.

According to Kang & Song(2010), the horseback riding simulation machine training for 15 minutes a day, 3 times per week, total 12 weeks showed significant increasing in all dimensions of GMFM. They recommended that the horseback riding simulating training should be considered as therapeutic method for physical therapy for the children with cerebral palsy to improve the functional movement.

Romeo et al(2018) suggested that Lycra suit are effective on improving for motor function and static balance in children with cerebral palsy. The five children with cerebral palsy wore the Lycra suit for more than 4 hour per day for 6 months. An immediate improvement of static balance was observed at baseline, with the first use of the Lycra suit. Further improvement was observed at the 6 month follow up, with a statistical significant for the parameters assessing the antero-posterior axis.

5. Intervention for in the future

Jan (2006) presented that the treatment must be goal oriented, such as to assist with mobility, reduce or prevent contractures, improve positioning and hygiene, and provided comfort. Each member of the child’s multidisciplinary team, including the child and both parents, should participate in the serial evaluation and treatment planning.

According Lowing et al (2009), the definition of goal directed therapy was a therapy that

emphasizes the learning of meaningful activities (expressed as goals) in the child's environment, wherein the activities are regarded as important by the child, the parents and others in the child's environment. The goals are established based on the parents' and children's priorities. Learning takes place in individually-tailored interventions in the child's natural environment by repetitive practice of the everyday goal activities, in a motivated, challenging and playful way, and in combination with impairment-focused interventions. The overall aim of the therapy is to improve everyday performance in activities and participation. In goal directed therapy, emphasis is directed towards the child and family in the goal-setting process with the aim to select goals that are meaningful in the lives of the child and family.
King et al (2004) emphasized that family centered service is both a philosophy and an approach to service delivery that is considered to be a best practice in early intervention and pediatric rehabilitation. And definition of family is that is made up of a set of values, attitudes, and approaches to services for children with special needs and their families. Family-centered service recognizes that each family is unique; that the family is the constant in the child's life; and that they are the experts on the child's abilities and needs. The Family works together with service providers to make informed decisions about the services and supports the child and family received. In family-centered service, the strengths and needs of all family members are considered.

Ⅳ. Conclusion

The definition of cerebral palsy is changing to focus on secondary problem over time from neurological condition and original impairment. Prevalence rate of cerebral palsy were 6~8% from perinatal asphyxia (Blair and Stanly, 1988), the overall prevalence of cerebral palsy has remained constant in recent years despite increased survival of at-risk preterm infants
The traditional classification by motor impairment or tone distribution will be less the impact than activities and participation in daily living activities.
The child with cerebral palsy is best cared for with an individualized treatment plan that provides a combination of interventions. This requires the provision of a number of family-centered services that make a difference in the lives of these children and their families

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