

APPROVAL SHEET

This case report is submitted in partial fulfillment of
the requirements for the degree of
Doctor of Physical Therapy

Caroline Calacci, SPT

Approved: May 2016

Preview from Notesale.co.uk
Page 2 of 65

Eric Shamus, DPT, PhD
Committee Chair

Sarah Fabrizi, PhD, OTR/L
Committee Member

The final copy of this case study has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

ABSTRACT

Introduction Cerebral palsy (CP) affects more children than any other physical disability. Despite the vast research pertaining to cerebral palsy, little is known regarding superior or optimal treatment options for this population. Previously, therapists have been instructed that strength training this population would cause an increase in spasticity but recent literature proves that children with CP can make gains in strength without decreasing their available range of motion. **Purpose** By completing this literature review and case report, extensive knowledge has been gained pertaining to the most effective treatment choices for children with CP. **Background Information** CP designates a group of permanent disorders of movement that is caused by non-progressive disturbances in the fetal or infant brain. There are many different classifications of CP and each child must be treated base on their individual impairments. The focus of this study was on spastic CP as approximately 80% of children with CP will present with spastic features. **Evaluative Analysis** Physical therapists must perform an extensive evaluation of children with CP including an evaluation of posture, tone, strength, range of motion, balance, gait, and overall functional mobility. **Treatment** There are a variety of treatment options for children with CP and this study intended to identify the most beneficial strength training parameters for this population. Children with CP benefit from the same exercise principles as typically developing peers including, specificity of training, adaptation, overload, and progression. **Case Report** An 8-week case report was completed focusing on the outpatient physical therapy management of an 11-year-old male with spastic CP. **Summary** Physical therapists plays an essential role in the treatment of children with CP and it is important to address the individual needs of each

Preview from Notesale.co.uk
Page 5 of 65

child. Physical therapy should incorporate strength training, aerobic training, stretching, along with other interventions focusing on the motor impairments involved with CP.

Preview from Notesale.co.uk
Page 6 of 65

who suffer poor nutrition, inadequate prenatal care, or who suffer diabetes, all have an increased chance of delivering prematurely.¹⁰ Serious physical trauma, including abuse or a fall, to the mother during pregnancy can cause serious injuries to the developing brain of the fetus.¹³ Several maternal-fetal infections are known to increase the risk for CP, including rubella, cytomegalovirus and toxoplasmosis. A fetal cerebrovascular accident can also increase the risk for CP. Until recently, intra-ventricular hemorrhage was the most common form of brain injury in the premature infant. Presently, pre-ventricular white matter injury has become the most common cause of brain damage.¹⁵ Rh incompatibility can cause kernicterus in the newborn. Kernicterus is a syndrome characterized by CP, high frequency hearing loss, visual problems, and discoloration of the teeth.¹⁴

CP is significantly more common in preterm and low- birth weight infants, and half of all cases occur in infants with weight of less than a kilogram at birth.¹⁶ The premature infant between 23 and 32 weeks' gestation is at the highest risk of periventricular injury.¹⁵ During delivery, anything that causes birth asphyxia such as, an umbilical cord around the neck or placenta previa, will reduce the amount of blood and oxygen that the infant brain is receiving and can result in CP. Prolonged or difficult labor because of a breech presentation can also contribute to asphyxia.¹⁴ Genetic syndromes, chromosome abnormalities, and brain malformations may contribute to cerebral palsy as well.¹⁰

If insult is not caused prenatally or peri-natally, it is possible that it can be caused post-natally. About, 20% of incidence of CP are caused post-natally resulting from bacterial meningitis, pediatric stroke, viral encephalitis, hyperbilirubinemia, or child

and dexterity.¹⁶ With UMN damage, muscles that are supplied by motor nuclei below the level of the lesion are affected in synergistic groups. Contralateral limbs will be affected when the lesion is above the decussation line in the pyramids, and ipsilateral muscles will be affected if the damage is below the decussation.²⁰ Hypotonicity generally occurs immediately following UMN injury, and spasticity develops later in recovery.²¹ Upper motor neuron damage is also caused from conditions such as a cerebrovascular accident, traumatic brain injury, multiple sclerosis, and spinal cord injury.²⁰

The presentation of CP can be global mental and physical dysfunction or it can be isolated disturbances in gait, muscle tone, growth, cognition, or sensation.² Along with the typical presentation of delayed motor development, abnormal muscle tone and hyper-reflexia, other commonly seen complications from CP include communication difficulties, excessive drooling, osteoporosis, osteopenia, fractures, dislocations, pain, and gastrointestinal abnormalities. Constriction of respiratory ability can occur with poor trunk control and physical therapists should consider each body system to be effected by CP.²¹ Physical therapists may be working along side occupational therapists, speech therapists, social workers, psychologists, physicians, respiratory therapists, orthotists, educators, neurologists, etc., when treating patients with CP.

One characteristic that is evident in CP is abnormal muscle tone, ranging from almost no muscle tone at all to extremely high muscle tone. High muscle tone is more common than low muscle tone in CP, and indicates damage to the pyramidal tracts and will accompany increased reflex responses.¹⁰ The abnormal tone is the nervous system's response to the initial brain damage and can fluctuate throughout the individual's lifespan. The child with CP suffers from a chronic loss of inhibitory suprasegmental

inputs, causing hyperactivity of the alpha motor neuron, which presents as increased muscle activity.²² The child's tone may fluctuate depending on positioning and tonal differences may be apparent in different parts of the body, with the trunk displaying low tone and any number of extremities displaying increased tone.¹⁴

Spasticity is a frequently observed symptom following upper motor neuron lesions including stroke, brain injury, spinal cord injury and CP.²⁰ Approximately eighty percent of children with CP will have spastic features, as damage to any part of the pyramidal tract will cause spasticity.¹⁰ Spasticity in children with CP is often characterized by a clasp knife quality¹⁰ where the limb catches at one point in the range, but is then released and able to move through the full range of motion.²³ Limbs affected by spasticity may have hyperactive deep tendon reflexes, clonus, muscular hypertonicity, uncoordinated movements and weakness.² Spasticity is dependent on the velocity of the movement so the speed of the stretch is critical when testing patients. Generally, more rapid movements are effective in eliciting hyperactive stretch reflexes in patients with spasticity.²³ In patients with spasticity, it is important to palpate the affected muscle groups, determine available ranges of motion, evaluate DTRs and perform tests for the Babinski sign and clonus.²⁰ Recruitment of the corticomotor neuron pool is affected with the presence of spasticity, which results in inappropriate timing and poor grading of agonist and antagonist muscle groups. Many individuals with CP will often develop neuromuscular scoliosis due to the asymmetrical pull of spastic muscles.²⁴ Due to the high rate of spastic features in children with CP, in this paper, treatment interventions will be focused on spastic CP. Spastic CP will be described as diplegia, hemiplegia, or quadriplegia.¹⁰

Primitive Reflexes

Assessment of the child's reflexes will be done by a physician to make the official cerebral palsy diagnosis but they should also be assessed by the physical therapist.

Primitive reflexes are normal early in life but should be integrated by twelve months of age. The primitive parts of the nervous system such as the spinal cord, the labyrinth of the inner ear, and the brain stem control these reflexes.³⁶ Three primitive reflexes that affect posture and movement are the asymmetrical tonic neck reflex (ATNR), the symmetrical tonic neck reflex (STNR), and the tonic labyrinth reflex (TLR).^{10,36}

Stimulus for the ATNR is active or passive rotation of the infant's head. When the head is rotated this causes the arm and leg of the side that the infant is looking toward to extend further, while the arm and leg on the side the child is turned away from take on a flexed position. The ATNR causes a change in muscle tone of the limbs and possibly the trunk. The ATNR is an appropriate reflex up to three months of age. Children with CP may never integrate the reflex and their volitional movement will be effected.¹⁰ The stimulus for the STNR is flexion or extension of the neck. When the neck is flexed, the upper extremities will flex and the lower extremities will extend. When the neck is extended, the upper extremities will extend, and the lower extremities will flex.³⁶ A persistent ATNR reflex can affect the child's ability to roll over while the STNR will prevent the child from reciprocal creeping or crawling.¹⁰

For the TLR, the stimulus is the position of the labyrinths in the inner ear. If the child is laying on their back, if the neck is extended, this causes the labyrinths to be tilted, eliciting the reflex and the legs will extend and the shoulders will retract. When the neck becomes flexed or the child is laying on their stomach, the hips and the knees will flex

The 6-Minute Walk Test (6MWT) is a common test used in the adult population but it has also been proven to be a valid and reliable submaximal exercise test in the spastic CP population, GMFCS levels I to III. The 6MWT can monitor changes in functional ability throughout childhood as well as assess function after surgical or nonsurgical interventions.²⁶ In a study by Fitzgerald et al.,²⁶ 145 children with CP aged 4 to 17 years old completed the 6MWT and their results were compared to normally developing peers. The average distance covered by normally developing individuals was approximately 528 meters (m). Children with CP, GMFSC level III walked an average of 305 m, level II walked an average of 387 m, and those classified as level I walked an average of 439 m, indicating that decreased endurance and cardiorespiratory function²⁴ have an impact on walking abilities.²⁶ The 6MWT can be used upon evaluation, and periodically throughout treatment to track the progress of ambulation distance in children with spastic CP.²⁶

TREATMENT OF CEREBRAL PALSY

The role of the physical therapist when treating CP is to place the child in situations that offer opportunities for motor learning and development of new motor skills. The overall goal of treatment is to maximize active functioning of the child, ease daily care, and minimize secondary complications such as pain, joint subluxations, and contractures.²² Many of the secondary impairments involved with CP are potentially preventable and with the proper interventions, may improve the motor skills and activity level of young children with CP.¹⁸ By minimizing the development and severity of secondary impairments, the individual with CP may reduce the high lifetime cost of medical care.⁹ Many interventions will cause a reaction that is unique to the individual

activities. He tolerates handling and is alert and cooperative during physical therapy evaluation, although he may require encouragement to participate in certain tasks. Upon review of the musculoskeletal and neuromuscular systems, multiple abnormalities and limitations were identified and are described below.

Posture and Observation

The patient demonstrates asymmetrical tone in his trunk and the right upper extremity and right lower extremity are hypertonic. He presents with a 1-inch leg length discrepancy with the right leg being shorter than the left leg. He has a pelvis obliquity with the right ASIS/PSIS lower than the left ASIS/PSIS. In standing in bare feet, the patient demonstrates right sided over pronation and increased calcaneal eversion. In sitting the patient demonstrates increased thoracic kyphosis. There is observed atrophy of right-sided gastrocnemius, hamstrings, quadriceps, biceps, and triceps. He frequently utilizes upper extremity support while in the seated position indicating suspected weakness of core musculature.

Gait and Functional Mobility

The patient ambulates independently. He demonstrates over-pronation with increased calcaneal valgus with slight internal rotation of the right lower extremity. He ambulates with circumduction of the right lower extremity with external rotation observed at the hip. He demonstrates flat foot initial contact. He occasionally demonstrates high steppage gait with the right knee excessively flexed. He is able to ascend from the floor to standing through right half kneeling but he requires external support. He is able to stand through left half kneeling independently. He is able to ascend and descend stairs using a reciprocal pattern with one hand supported on the railing. He is

58. Nwaobi OM, Smith PD. Effect of Adaptive Seating On Pulmonary Function Of Children With Cerebral Palsy. *Developmental Medicine & Child Neurology*. 2008;28(3):351-4.
59. Washington KA. The Effects Of An Adaptive Seating Device On Postural Alignment and Upper Extremity Function In Infants with Neuromotor Impairments. *Pediatric Physical Therapy*. 1997;9(4):206.
60. Begnoche DM, Chiarello LA, Palisano RJ, Gracely EJ, Mccoy SW, Orlin MN. Predictors of Independent Walking in Young Children With Cerebral Palsy. *Physical Therapy*. 2015;96(2):183-92.
61. Rosenbaum PL, Walter SD, Hanna SE, et al. Prognosis for Gross Motor Function in Cerebral Palsy: Creation of Motor Development Curves. *JAMA*. 2002;288(11):1357-63. doi:10.1001/jama.288.11.1357.
62. Fedrizzi E, Facchin P, Marzaroli M, et al. Predictors of Independent Walking in Children With Spastic Diplegia. *Journal of Child Neurology*. 2000;15(4):228-34.
63. Begnoche D, Pitetti K. Effects of traditional treatment and partial body weight treadmill training on the motor skills of children with spastic cerebral palsy: a pilot study. *Pediatric Physical Therapy*. 2007;19:11-9.
64. Mattern-Baxter K, McNeil S, Mansoor JK. Effects of home-based locomotor treadmill training on gross motor function in young children with cerebral palsy: a pilot, randomized controlled trial. *Archives of Physical Medicine and Rehabilitation*. 2014;95(11):2061-7.
65. Jung T, Kim Y, Kelly LE, Abel MF. Biomechanical and perceived differences between overground and treadmill walking in children with cerebral palsy. *Gait & Posture*. 2016;45:1-6.
66. Khamis S, Martikaro R, Wientroub S, Hemo Y, Hayek S. A functional electrical stimulation system improves knee control in crouch gait. *Journal of Children's Orthopaedics*. 2015;9(2):137-43. doi:10.1007/s11832-015-0651-2.
67. Usuba K, Oddson B, Gauthier A, Young NL. Changes in Gross Motor Function and Health-Related Quality of Life in Adults With Cerebral Palsy: An 8-Year Follow-Up Study. *Archives of Physical Medicine and Rehabilitation*. 2014;95(11):2071-2077.
68. Day SM, Wu YW, Strauss DJ, Shavelle RM, Reynolds RJ. Change in ambulatory ability of adolescents and young adults with cerebral palsy. *Developmental Medicine & Child Neurology*. 2007;49(9):647-53.