

Two Months of Catching Up Walking Ability in 3-Year-Old Girl with Spastic Diplegic Cerebral Palsy: Comprehensive Rehabilitation Program Involving the Family

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Abstract: A 3-year-old girl was presented to our clinic with a chief complaint of not being able to stand and walk unsupported. She was born prematurely on 31 weeks of gestation and was diagnosed with spastic diplegic cerebral palsy (CP) at the age of two years. During supported standing, she still had noticeable equinus on both of her feet. We gave comprehensive rehabilitation consisted of a hospital-based and home program. Hospital-based management was done two times per week included dynamic neuromuscular stabilization (DNS) technique and conventional exercise such as stretching, strengthening, and postural control exercise. The home program was done three times per day consisted of DNS, swimming, cycling, standing in an inclined surface, squat to stand exercise and stretching exercise. After two months of a rehabilitation program, she was able to stand unaided and walk 2-3 steps independently. We also added botulinum toxin injection on her gastrocnemius muscle and hinged AFO prescription to improve her walking ability. Comprehensive rehabilitation program involving healthcare providers and family is an effective approach in catching up walking ability in a patient with spastic diplegic cerebral palsy.

1 INTRODUCTION

Cerebral Palsy (CP) applies to a non-progressive neurodevelopmental disorder caused by an insult to the developing brain, in which the primary clinical manifestation is a motor deficit. A total of 17 million people are estimated to have cerebral palsy with worldwide prevalence is approximately 2.11/1000 live births (Sharan et al., 2016). CP patients have a nonprogressive brain lesion accompanied by motoric clinical manifestation that may change over time during their growth and development. Spastic diplegia cerebral palsy is a form of CP, with affected people have increased muscle tone which leads to spasticity in the muscle (Azar et al., 2015).

In rehabilitation of children with cerebral palsy (CP), varying approaches and techniques are used, ranging from very conservative and conventional techniques, such as muscle strengthening, manual stretching, and massage, to more complex motor learning-based theories, such as neurodevelopmental

treatment, conductive education, and several others (Balci, 2016).

Even though the loss of brain function in CP cannot be fully recovered, the evolving medical intervention has been able to reduce secondary complications and increase patient participation in activities of daily living. However, the management of CP is complex and must be tailored to each specific individual due to the wide variance between CP cases (Jan, 2006; Kolar et al., 2013). Of the medical management strategies for CP, rehabilitation plays a key role in managing symptoms, preventing secondary complications, and improving the child's self-care abilities and independence (Kolar et al., 2013).

Rehabilitation of CP comes in two forms: home-based and hospital-based treatment. Several studies have shown that home-based treatment gives a beneficial result and a lot more cost-effective than hospital-based treatment (Azar et al., 2015). Comprehensive rehabilitation therapy requires a multidisciplinary approach that includes family and

healthcare providers. Both parties are needed to establish a suitable approach to reach a desirable goal (İçağasıoğlu et al., 2015).

CP rehabilitation treatment is intended to reduce or prevent secondary musculoskeletal complications rather than the primary neurological deficit. Most rehabilitation strategies are based on the principle of neuroplasticity, postural control, balance, muscle stretching and strengthening (Azar et al., 2015). Rehabilitation is aimed to reach optimal physical, sensory, intellectual, psychological, and social function (Balci, 2016). There is no scientific evidence to compare the benefit of one strategy to another. The duration and frequency of each therapy have not yet been established. This study aims to investigate the result of comprehensive rehabilitation therapy consisted of home-based and hospital-based rehabilitation, combined with orthotic use and botulinum toxin injection to improve walking ability in children with cerebral palsy.

2 CASE PRESENTATION

A 3-year-old female child was presented to pediatric rehabilitation outpatient in November 2018 with a chief complaint of walking difficulty. She was already able to stand up on her toes, with her hand grasping the surroundings to stabilize her body. However, she could not yet walk independently and still needed aid or support to transfer herself from sitting to standing position.

She was born at 31 weeks gestation and later diagnosed with spastic diplegic CP since birth due to preterm delivery. From history-taking, we found that the patient had delayed motor development as summarized in Table 1. She had undergone physiotherapy at her previous hospital since she was 1,5 years old. Nevertheless, by the age of 3 years, she still required assistance in standing up from a seated position and was unable to ambulate unaided. Thus, her parents wanted to seek a second opinion and for re-evaluation from our department. She had a previous history of congenital talipes equinovarus (CTEV), which was successfully treated by casting. Spina bifida was not found in this patient. Currently, she uses bilateral solid ankle-foot orthoses (AFO) to walk.

Table 1. Patient's initial gross motor development milestones

Milestone	Age
Rolling	6 months
Sitting unaided	10 months
Standing up by holding the hand	1 year
Standing up unaided	Unable
Walking	Unable

On physical examination, her general status was found to be normal. She had full ROM in all the lower extremity muscle groups. Motor strength examination revealed apparent Manual Muscle Testing (MMT) of 4 on her bilateral hip extensors, hip flexors, knee extensors, and knee flexors; MMT of 1 on her bilateral ankle dorsoflexors. Spasticity was found in both gastrocnemius muscles (Australian Spasticity Assessment Scale / ASAS 3 for her right gastrocnemius and ASAS 2 for her left gastrocnemius) with positive Silfverskiöld test. There was no spasticity on her upper extremities. Both Thomas and Ely's test results were negative, indicating no tightness or spasticity in the hip flexors. She required assistance in standing up. While standing up, ankle valgus and slight pronated foot were observed along with pes equinus posture and a forward shift of the trunk. She had poor hip control and was unable to ambulate independently. The patient scored 0 on the standing dimension and 3 on walking dimensions of the Gross Motor Function Measure (GMFM) at the initial examination.

A comprehensive medical rehabilitation program consisted of hospital-based and home-based rehabilitation was given to the patient. The hospital-based rehabilitation program was done twice weekly involved Dynamic Neuromuscular Stabilisation (DNS) technique and also a conventional exercise included stretching exercise, strengthening exercise, and postural control exercise. DNS technique for this patient included trigger zone activation started with trigger zone stimulation in the 5th-6th intercostal space and the anterior superior iliac spine. As a part of this technique, we also gave the developmental position in 5 months old child position (patient in the supine position, raising and flexing both hips and knees). DNS lasted for 20 minutes each session. Home-based rehabilitation program including bicycle training, swimming, squat to stand exercise, manual stretching, standing with backslab. DNS was also prescribed as a home program, which was done by her mother for 20 minutes, three times daily. The patient went

swimming twice weekly for 30 minutes since the start of the program. Her mother also manually stretched her muscles especially gastrocnemius muscle twice daily with 30 repetitions per session.

Two months in the program, she could move from sit to stand independently. She could stand unsupported for 5 minutes without backslab, and more than 15 minutes when using backslab. She was able to walk independently for 2–3 steps unaided using solid AFO she got from the previous hospital. At that time, she scored 10 in standing and 9 in walking dimensions of GMFM.

We continue all of the programs. For the DNS technique, we added stimulation on her lateral calcaneus. We also added walking exercise unsupported or supported with the chair as a home program exercise.

Re-evaluation at six months after the rehabilitation started showed improvement in postural control and walking function. She could stand unaided for 30 minutes. She was able to walk for 100 meters unaided and able to cycle her tricycle unaided. To optimize her gait, we changed her previous solid AFO to hinged AFO. We gave her botulinum toxin injection on her bilateral gastrocnemius muscles to reduce her spasticity. Her scores on the GMFM standing and walking dimensions also improved to 27 and 20, respectively.

This case report showed walking ability improvement that was achieved two months after the rehabilitation program started. The better function was remarkable after 6 months of rehabilitation.

3 DISCUSSION

Spastic diplegic CP in our patient was confirmed with existing movement and postural control disturbance that caused gross motor development delay since her early life. Prematurity was suspected as a risk factor of cerebral palsy in this patient.

The patient came to our clinic in non-ambulatory conditions despite having already received rehabilitation treatment from another hospital since the age of 1,5 years old. She could only stand up aided at the time of the first presentation. After she came to our clinic, comprehensive rehabilitation treatment consisted of a hospital-based and home-based program that was given to the patient. We choose to collaborate with family members to establish family-centered models to improve her walking ability. A successful collaboration between health care professionals and family members has

been reported to give a good result in pediatric rehabilitation settings. This method needs good communication between both parties which include effective information exchange, competency of health care professionals in identifying both the patient and family's needs and potentials, and the determination of family members to be involved in the program. This approach allows us to deliver an effective rehabilitation service that suits each family because every family is different (Balci, 2016).

For the hospital-based program, we prescribed two times weekly DNS treatment lasted for 20 minutes each session. Her DNS program mainly involved stimulation by activating specific trigger zones. Trigger zone stimulation involves the activation of various muscle groups that contributes to postural control. It stimulates the brain to learn to use the appropriate muscles in a specific postural task and strengthen the muscles involved, which can potentially improve postural control. A study investigating the effect of DNS in CP patients showed significant improvement in activation of the transverse abdominal muscle and the internal oblique muscle, both of which play a central role as core stabilizers, thus contributed to improved postural control in our patient (Kolar et al., 2013). We also gave the conventional exercise to reduce equinus, strengthen the muscles, and reach good postural control.

The home program consisted of DNS, swimming, cycling, standing in an inclined surface, squat to stand exercise and stretching exercise. These exercises increased her overall cardiorespiratory endurance, coordination, sensory input, and strength. Research on home-based physical exercises for muscle strengthening had shown improvement in gait pattern for children with cerebral palsy when was done daily for 6 weeks in young CP patients between eight and eighteen years old (Patrícia et al., 2012). Swimming is a type of aerobic exercise also contributed to ameliorating overall walking ability, accounted for the improvement in cardiorespiratory endurance. Even though limited evidence was found on how manual stretching could improve walking ability, research has shown that stretching could reduce spasticity. For this reason, we still prescribed stretching exercises to the patient (Pin, Dyke, and Chan, 2006; Novak et al., 2013).

She demonstrated type 3 gait deviation according to Amsterdam Gait Classification (Becher, 2002), shown by knee hyperextension and heel rise during the midstance phase. We chose to change his orthotic treatment using hinged AFO. Hinged AFO

is indicated for ambulatory, active children which we hope to be able to walk up the stairs. This type of orthosis increases stance stability, normalize the first contact, and control knee stability. It increases dorsoflexion which in turn decreases genu recurvatum and increases toe clearance. Hinged AFO corrects equinus and provides energy-efficient gait (Miller, 2005; Ofluo, 2009).

We gave a botulinum toxin injection to decrease her spasticity in bilateral gastrocnemius muscles. Botulinum toxin has been proved to be an effective drug to relieve spasticity by multiple trials (Kaushik et al., 2018). A systematic review involving several good quality Randomized Controlled Trials have investigated the outcome of injection of botulinum toxin for equinus with positive results utilizing objective outcome measures (Love et al., 2010).

Improvement in walking and postural control was shown after two months of rehabilitation. A remarkable improvement was noticed after six months of rehabilitation; she could stand for 30 minutes unaided, cycle her tricycle independently, and able to walk for 100 meters unaided. These improvements were achieved from a comprehensive hospital rehabilitation program and support from the family to comply with the home program.

There was no adverse effect identified during the study.

4 CONCLUSIONS

A hospital-based and home-based rehabilitation program is an effective approach for patients with CP. We gave DNS technique, hinged AFO, botulinum toxin injection, and conventional exercise. We also encouraged the family to do the home program. DNS is a new method that can be applied as hospital-based and home-based treatment. Family support is an important aspect of a successful rehabilitation program. This case report shows the result of comprehensive rehabilitation treatment involving both healthcare providers in hospital-based setting and family as a caregiver in a home setting.

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