Individualized intermittent intensive physiotherapy program to improve the standing balance in a child with spastic diplegia : A case report

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ABSTARCT

Background and purpose: Conventional physiotherapy is effective in improving the strength, coordination, balance and independence in functional abilities in a child with cerebral palsy. Recent evidences proved that intermittent intensive physiotherapy (IIPT) is effective for children with cerebral palsy (CP), but it described inconsistently throughout the research. So the purpose of this case report was to find out the effectiveness of an individualized intermittent intensive physiotherapy program for a child with CP.

Case description: The patient was a 4.5-year-old boy with spastic diplegia, Gross Motor Function Classification System (GMFCS) level III. The intermittent intense physiotherapy was tried over an 8 week period. Therapy session included a 3-week, 3 times per week intensive therapy phase, followed by a 1-week resting phase. Intervention included stretching, strengthening exercise; balance training and family instruction. Outcomes were assessed by using the quadriceps strength, knee range of motion, double leg balance time, one minute walking test and Gross Motor Functional Measure (GMFM)-66.

Results: The patient demonstrated a gradual increase in quadriceps strength (R-60/20 to 95/20, L-73/20 to 95/20), knee range of motion(R – 110^0 to 120^0, L-118^0 to 128^0), double leg balance time (38 seconds to 102 seconds), one minute walking test (650 cm to 825 cm) and GMFM-66 (61 to 68) scores throughout the 8 week period covered by this case report, with the greatest mean change score obtained when the intermittent intensive therapy schedule was used. Patient were maintained the improved motor performance during rest periods.

Conclusion: The intermittent intense physiotherapy program was effective in this child with CP.

Key words: intermittent intense physiotherapy, cerebral palsy, GMFM

INTRODUCTION

Cerebral palsy (CP) is non-progressive disturbances in developing fetal or infant brain characterized with abnormality in movement and posture. Cerebral palsy is often associated with disturbances of sensation, perception, cognition, communication, and behavior, epilepsy, and secondary musculoskeletal problems[1]. The prevalence rate of cerebral palsy in the general population is 2/1000[2,3].

Spastic diplegia (10 – 30%) is a type of cerebral palsy.It is most common among cases prematurity and postnatal complication of premature birth. It is highly correlated with the ultrasonographic finding of preventricular leukomalacia[4,5].

Children with cerebral palsy have predominant involvement of lower extremity, although almost all have some degree of upper extremity involvement, often manifesting as impaired fine motor skills, with increased muscle tone (spasticity), increased deep tendon reflex, and a Babinski reflex. Overall, 50% of CP cases are mentally retarded but the percentage in spastic diplegia is lower. Learning disabilities and attention disorder are very common in this population. Hip, knee and ankle contracture can interfere with subsequent ambulation[6].

Traditionally we treat CP patients with low to moderate resistance depending upon their functional abilities, but recent studies have shown effectiveness of training CP patient with

intermittent intensive therapy.

So this case study aims to describe the effectiveness of intermittent intensive therapy in a spastic diplegic cerebral palsy child.

MATERIAL AND METHODS

The study design was single case experimental study. The child's motor performance was examined before and after 8 week of IIPT intervention.

CASE REPORT

This 4.5-year-old boy, weighing 18.5kg was born preterm by normal vaginal delivery with complication during delivery. Antenatally there was no history of any maternal illness, history of any drug ingestion or exposure to radiation. MRI scan revealed leukomalacia and the baby was diagnosed with hypoxic ischemic encephalopathy. The child took physical therapy for 3 years in Oman and then shifted to U.A.E and continued his treatment in Gulf Medical Hospital, Ajman. The child was alert, conscious, had low IQ and was able to crawl, sit independently but wasn't able to stand and walk without assistance. On observation he was obese stage-I, most adaptive position was sitting and while assisted standing his knees were flexed and adducted into crouch position. He uses kneeling and assisted/supported walking for ambulation. On examination he had normal cranial nerve and sensory function. His knee and ankle reflexes showed hyperreflexia on both sides. He had ankle clonus. His both hamstring spasticity level was Grade 3 and gastronemeous level was grade 1 in modified Ashworth scale. Themuscle strength of the quadriceps on right was 2- and on left was 2+ in Manual Muscle testing scale. He had tightness in iliopsoas and hamstring muscles on both sides. He had pronated foot with excessive dorsi flexion. His hand grip was weaker in right side than left side. He can able to do sit up from lying down position without any assistance. His sitting balance was grade 3 on functional balance scale. He was not able to do stand without support but his hip flexed and externally rotated, knee flexed and ankle pronated and dorsi flexed on supported standing and assisted walking. His independent level was grade 3 on gross motor functional measure. Plan of care for this patient was to reduce spasticity, develop lower limb mobility control, and develop standing balance and walking ability. He was undergoing cryotherapy, stretching, passive and assisted movement, strengthening exercises, balance and functional training for 45 minutes per day, 2 days per week. PT included the intensive physiotherapy program to achieve more standing and walking control.

INTERVENTION

The intensive therapy included stretching of the lower extremity for 30 minutes to prepare the body for functional activities. Manual stretching was focused primarily on the hamstrings and adductors. ½, 1 and 1½ kilogram weights were used to isolate and strengthen knee extensors. The target was 8 – 10 repetition, 2 – 3 sets per day for 3 times per week. The child performed activities to challenge balance, coordination, weight-shifting, half-kneeling, tall kneeling, double leg stance, stepping using straps and manual facilitation[7].

OUTCOME MEASURES

Isometric Knee Extensors Strength (IKES)

The modified sphygmomanometer is one of the measurement tools for IKES. According to Helewa et al., the child was made to sit in high sitting position, the sphygmomanometer was inflated to a baseline reading on the aneroid scale (20 mmHg) and kept over the shin of tibia. The child was asked to attempt to produce knee extension by exerting force against the therapist. The child produce "break" in movement or a tremor during movement was indicated the maximal isometric contraction. Child was asked to repeat this procedure for three times and the greatest force (mmHg) was recorded for the analysis[8].

Goniometry

Goniometry is one of the fair to good reliability measurement tool to measure joint range of motion. The child was positioned in supine position to measure the passive knee extension. The greater trochanter and the lateral epicondyle of the femur and lateral malleolus were palpated for goniometer fixation. The child's hip was kept in 90 degrees of flexion. The first therapist passively extended the knee to the point of maximal resistance and another physiotherapist measured knee passive range of movement. These same two therapists were used in pre- and post-intervention goniometric measurements in order to reduce the error in measurement[9].

Timed standing balance

This was assessed using a stopwatch as the longest time in seconds for which each subject could stand on their leg with their eyes open. Standing balance times were transformed using a natural logarithm to normalize the distribution[10].

One minute walking test

*The 1-Minute Walk Test(1 MWT) was one of the test to measure t*he walking ability in given time in cerebral palsy children. The child was asked to walk in a 20–22 m figure of eight-shaped, flat, smooth, non-slippery oval walking track for 1 minute. Child was allowed to use the shoes including splints, and used his usual front wheel attached walker aid. Child was allowed to walk from a standing position after the start command instruction. The child was allowed to walk at his own comfortable speed for 1 minute. Distance (in meters) covered by this child in 1 minute was noted to calculate the fast walking speed[11].

Gross motor functional measure(GMFM)

The GMFM was one of the tools to measure the gross motor function of children less than 5 years of age. This test was measured under following dimensions: (A) Lying and Rolling; (B) Sitting; (C) Crawling and Kneeling; (D) Standing, and (E) Walking, Running, and Jumping which consist total 88 item. 4-point Likert scale was used to grade each item and a percentage score is calculated for each dimension was analyzed by percentage of subtest score. The mean of the five dimension scores was considered for total GMFM score which was used in the analysis[12]. The GMFM test procedure assessed the child before the intervention and every 4 weeks. Testing conditions were standardized according to the protocol developed by Russell and coworkers[13].

RESULTS

Primary outcome measure

- Table 1 shows the increment in muscle power from 60/20 to 80/20 and 73/20 to 86/20 respectively in right and left quadriceps muscle at the end of 3rd week.
- After 8 week training the both side quadriceps were increased from 60/20 to 95/20 and 73/20 to 95/20 respectively.

Table 1. Net gain in quadriceps muscle strength and passive knee extension range of motion.

	Pretest	End of			
		3rd week	4th week	7th week	8th week
Quadriceps muscle strength(R)	60/20	80/20	80/20	95/20	95/20
Quadriceps muscle strength(L)	73/20	86/20	85/20	98/20	95/20
Passive - Knee extension ROM(R)	0 - 110	115	113	121	120
Passive - Knee extension ROM (L)	0 - 118	125	124	128	128

- The both side quadriceps muscle power were maintained during rest periods
- Above mentioned table shows the increment in passive knee extension ROM from 110^0 to 115^0 and 118^0 to 125^0 respectively in right and left knee at the end of 3rd week.
- After 8 week training the passive knee extension were increased from 110^0 to 120^0 and 118^0 to 128^0 respectively on right and left side knee joint.
- The both side passive knee extension were maintained during the rest periods.
- Table-2 shows the increment in double leg stance time from 38 seconds to 56 seconds at the end of 3rd week.
- After 8 week training the double leg stance time were increased from 38 seconds to 102 seconds.
- The double leg stance time were maintained during rest periods.

Table 2. Net gain in double leg stance time, one minute walking test and GMFM

		End of			
	Pretest	3rd week	4th week	7th week	8th week
Double leg stance time (sec)	38	56	60	102	102
One minute walking test (cm)	650	725	720	830	825
GMFM	61	65	64	68	68

- Above mentioned table shows the increment in One minute walking test score from 650 cm to 725 cm at the end of 3rd week.
- After 8 week training the One minute walking test score were increased from 650 cm to 825 cm.
- The One minute walking test score were maintained during the rest periods.
- The increment in GMFM score from 61 to 65 at the end of 3rd week.
- After 8 week training the GMFM score were increased from 61 to 68.
- The GMFM score were maintained during the rest periods.

DISCUSSION

The aim of this case study was to focus on the effectiveness of intermittent intensive physical therapy (IIPT) on spastic diplegic cerebral palsy child. Table-1 demonstrates the physical and functional characteristics of spastic diplegic cerebral palsy. This case study showed the modified sphygmomanometer is an easy method to obtain quadriceps muscle strength for spastic diplegic cerebral palsy child. The one minute walking test is convenient and not fatigable to measure the walking ability for early ambulatory spastic diplegic child.

The result of this study showed that the quadriceps muscle power and knee range of motion improved significantly throughout the physiotherapy session after the IIPT (Table – 2). The small improvement in quadriceps muscle strength and knee range of motion observed was also well within the range of improvements observed in previous training studies in children with cerebral palsy[14]. The child

was able to maintain the muscle strength and range of motion of knee without any deterioration during the rest period.

At the end of 8 weeks of intensive physical therapy protocol the child was able to stand for long period of time, walk comfortably and functional improvement was also noted. The table-2 explains the significant changes in double leg stand time, one minute walking test and GMFM scores. As mentioned above, Trahan J et al[15] found that functional ability and gross motor function were improved after the intensive physical therapy intervention. This case study results showed that intermittent intensive physiotherapy protocol was effective in improving functional control in a child with cerebral palsy. Considering these result further detailed longer duration, high intensity training, group training or earlier intervention studies needed to validate the intermittent intensive therapy program and its effectiveness in children with cerebral palsy.

CONCLUSION

This case study showed that the individualized intermittent intensive physical therapy program were effective in improving static standing balance and functional performance in spastic cerebral palsy child. The motor performance of this child did not deteriorate during the rest periods without therapy. Future study is needed to develop appropriate parameter for intermittent intensive physiotherapy program and its long term effect in children with spastic diplegic cerebral palsy.

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