Functional Strength Training In Children With Spastic Cerebral Palsy

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ABSTRACT

To find out functional strength training exercise on improving gross motor function among the children with spastic hemiplegic cerebral palsy children. Single group pre-experimental research design. The most common cause of movement disability in infancy is cerebral palsy. Cerebral palsy patients have impairments such as spasticity, low muscle strength and selective motor control in their body function. Such deficiencies may limit activity performance and participation in everyday life. Improving and optimising activities and involvement are crucial treatment objectives. Functional strength workouts are vital to overcoming obstacles to improving the functionality of children with neurological issues. 92 subjects of spastic hemiplegic cerebral palsy aged 4-8, male and female with spastic hemiplegic cerebral palsy were selected under purposive sampling technique and received functional strength training exercise for a period of ten weeks. To assess the gross motor function (functional independence) pre and post the exercise program, Gross motor functional measure was used. Results: The pre and post measurements shows significant changes in the gross motor function among children with spastic hemiplegic cerebral palsy. The results of the post-test mean values show improvement in gross motor functions after functional strength training program (p<0.05). The functional strength training program proves that increased gross motor function and thereby improvement in functional abilities among children with spastic hemiplegic cerebral palsy after ten weeks of intervention.

INTRODUCTION

The Cerebral palsy (CP) is a movement and posture disorder not progressive but not unalterable due to the abnormality of the nervous system that is developing. A conglomerate of complexities exists in brain dysfunction. The diagnosis referred to a short time before, after or during the birth process lack of oxygen in the brain or during the process of birth (Sathish and Swarnakumari, 2017). CP is an insult to the developing brain that mainly affects motor function. In 2–2.5 out of 1000 births, it is the most common cause of childhood disability (Elanchezhian and SwarnaKumari, 2019). Because cerebral paralysis has diversified features in muscle tone and movement disorder because of brain damage, it can be classified as a spastic cerebral palsy (60–70%), and ataxic type depending on the predominant abnormal movement. Spastic hemiplegic is a common type of upper and lower side of the same body side involvement (Kwon, 2016).
Table 1: Functional strength training protocol

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Position</th>
<th>Instruction</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seated calf raise (Figure 1)</td>
<td>Seated with hips flexed at 90°, knees flexed at 90°, feet flat on the floor approximately 30 cm apart. Sand bags held on training leg, above the knee. Non-training leg resting with foot flat on the floor</td>
<td>The subject to hold the sand bag on to his knee and keep your toes on the floor; slowly raise his/her heel up towards the roof until the subject can’t go any further. Slowly lower his/her heel down to the floor</td>
<td>Advice to lift the weight by raising the heel up using the ball of the foot until the ankle is in maximum plantar flexion before lowering the heel to return to the resting position. Hold the position for 3 seconds. It is repeated for 10 times.</td>
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<tr>
<td>Standing calf raise</td>
<td>Standing upright on a 20 cm step, holding a hand rail if required. Place sand bag in on training leg side, heels hanging approximately 10 cm off the step. Non-training leg resting position</td>
<td>The subject is asked to hold the knee straight and toes on the step, slowly raise his /her heel towards the roof until he /her can’t go any further. Slowly lower the heel down again until it hangs slightly below the step</td>
<td>Raise the heel up using the ball of the foot until the ankle is in maximum plantar flexion before lowering the heel to return to the resting position. Hold the position for 3 seconds. It is repeated for 10 times.</td>
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<td>Tibialis anterior raise (Figure 2)</td>
<td>Seated with hips flexed at 90°, knee flexed at 70°, training foot secured in sand bag. Non-training leg resting with floor-foot flat</td>
<td>The subject is asked to lift the front of his / her foot up, keeping the knee bent and heel on the floor until her /she can’t go any further. Lower the foot back down again slowly</td>
<td>Lift the weight by dorsiflexing the foot, keeping the heel on the floor, until the ankle is maximally dorsiflexed before lowering the forefoot to return to the original position. Hold the position for 3 seconds. It is repeated for 10 times.</td>
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<tr>
<td>Seated straight knee calf press</td>
<td>Seated with hips flexed at 70°, training leg knee at 0°, foot flat on the raised floor with the heel hanging approximately 10 cm below the raised floor. Non-training leg resting with foot flat on the floor</td>
<td>The subject is asked to slowly push the floor forward with the front of his /her foot, keeping your knee straight, and then bring it back towards slowly</td>
<td>Use the ball of the foot to plantar flex, pushing the raised floor forward before dorsiflexing the ankle to return to the original position. Keep the back flat against the support pad for the duration of the movement. Hold the position for 3 seconds. It is repeated for 10 times.</td>
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Muscle weakness in CP is prevalent, with almost all patients affected by the ankle joint. Muscle atrophy and connective tissue disturbances have been reported in the CP, such as increased collagen and adipose infiltration. Despite the knowledge that these adverse changes can be reversible, muscles are one of the most plastic tissues in the body. Recent evidence indicates that muscle size is directly associated with levels of mobility and physical activity in CP (Damiano et al., 2013). CP people’s motor disorders often involve loss of functionality and rely on others to meet their everyday needs. Inactivity leads to the restoration of various physiological systems. Inactivity leads, the result of physical deterioration and future performance deterioration (C and P, 2019).

Physical therapy is mainly concerned with gross motor or main leg-related muscle activities, such as walking. Weight training may not be appropriate for very young children. However, therapists can include enhanced activities in children’s therapy using games and functional movements.

Impairment of muscle strength and motor control is the leading cause of deficiencies in motor performance in children with brain paralysis. The impaired power and motor control of children with cerebral palsy is the primary cause of motor control deficits. Impairments in muscle strength and motor control have been a significant cause of motor performance in children with cerebral palsy. Impairments in muscle and motor control have been a substantial cause of deficiencies in motor performance in children with cerebral palsy.

Strength gains could be better transferred into improving functional motor performance if more functional closed kinetic chain exercises are involved in strengthening exercises. The subject is weight-bearing through the feet and the body’s mass increases and falls across the feet through concentrated and eccentric action of the muscles in the lower limbs, which features in many activities involving the lower limbs, such as standing and walking (Blundell, 2003).

Depending on the age of the child and the nature and severity of the limited movement skills, many treatment modalities have been developed in the

### Table 2: Comparison of GMFM values pre and post.

<table>
<thead>
<tr>
<th>GMFM</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Paired t test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>149.47</td>
<td>22.47</td>
<td>-11.454</td>
<td>0.000*</td>
</tr>
<tr>
<td>Post-test</td>
<td>177.40</td>
<td>29.49</td>
<td></td>
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</table>

In children with CP, abnormal gait is a common issue. Their walking ability is highly likely to deteriorate as they mature. Gait differences in gait velocity, reduced step length and time on a higher leg and reduced stride-length joint excursion and acceleration, compared to a counter-lateral extremity, typically include slightly lowered gait velocity in those children (Druzbicki, 2013).

Toe walking in children who might have spastic hemiplegic brain dysfunction is amongst the most frequent clinical problems. The leading cause is the reduced muscle force of the dorsiflexor ankles secondary to the motor cortex or corticospinal tract lesion. This maturing process is less strictly observed on the side most affected by the CNS lesion in children with congenital hemiplegic cerebral paralysis and foot drop (Willerslev-Olsen et al., 2015).
last decade. Therefore in this study, the functional strength training of children affected by spastic hemiplegic cerebral paralysis would lead to the activities of daily living. This study suggests that children would gain functional activities. It will also help to clear the misconception that the spasticity and functionality of cerebrally paralysed children will increase with functional power formation.

**MATERIALS AND METHODS**

**Study setting and population**

Department of Physiotherapy, White Memorial College, Kanyakumari. Various physiotherapy centres in and around Kanyakumari and Kancheepuram districts. Ninety-two spastic hemiplegic cerebral palsy children were selected for the study.

**Design**

In this study, the main objective was to find out the effectiveness of functional strength training on improving the functional activities in spastic hemiplegic cerebral palsy children. The research design used in the study was single group pre and post-experimental design. The assessment was taken before and after the administration of the functional strength training program.

**Subjects**

Subjects with the age group of 4 to 8 years of age, spastic hemiplegic cerebral paised children and able to walk independently with or without walking aids were included in the study (Blundell, 2003). Subjects were excluded from the study if they were known to be cognitively impaired, if they were non-ambulatory, or if they had an orthopaedic or medical condition that prevented them from exercising. Children underwent any surgery or treatment of botox injection and other types of cerebral palsy also excluded.

**Outcome measure**

The tool used in the study was Gross Motor Function Measure (GMFM-88) an observational clinical tool designed to evaluate the change in gross motor function. The scoring system of the GMFM is a four-point scale divided into five categories (lying and rolling; sitting; crawling and kneeling; standing; walking, running) (Ko and Kim, 2013).

**Procedure**

After getting the concern from the parents of the children with spastic hemiplegic cerebral palsy, the children were assessed for pre-test scores on gross motor function measure scale before undergoing functional strength training. The functional strength training program was given individually depends upon their physical status. The subjects followed the exercise protocol stated in Table 1. All exercise is carried out for 30 – 40 minutes a session, and each exercise is carried out to hold the position for 3 seconds. It is repeated for ten times. The exercise protocol is carried out four times a week for ten weeks (Gillett et al., 2016; Ryan et al., 2016).

**RESULTS AND DISCUSSION**

The raw data were tabulated in an excel sheet to analyse the effects of the functional strength training program. The data were analysed using SPSS software version 17, the statistical tool dependent sample “t” test or paired t-test was used. The number of subjects for the study was 92 (n=92). The subjects were involved in the pre-test assessment by GMFM. Treatment was given for ten weeks, four sessions per week. According to Table 2 the values of GMFM with functional strength training for pre-test mean = 149.47, standard deviation = 22.47 and post-test mean = 177.40, standard deviation= 29.49, The T-value was -11.454, The p-value was 0.000. This was statistically significant. Hence it is evident from the table that values are significant, which infers that there was a significant improvement in gross motor function following functional strength training.

Dimensions from GMFM (walking, standing, running and jumping) – Show mean value, standard deviation, Period T-value and P-value between pre-test and post-test scores in functional strength training. This study intended to find out the effect of functional strength training on gross motor function measure and thereby the functional independence of the spastic hemiplegic cerebral palsy children. All the 92 subjects followed the functional strength training program without any discomfort. The significant improvement in the gross motor function is attributed to the functional strength training program.

GMFM scores of all the 92 spastic hemiplegic CP children were taken before and after the intervention program. The intervention program was given for ten weeks as per the protocol provided in the procedure. After finishing the pre-test assessment, the calculated mean pre-test score was 149.47, and after the intervention for ten weeks, the post-test mean score was 177.40, and it shows statistically that p<0.005. This was supported by a study done by Franchi MV et al., have also illustrated that strength training conducted between 12 to 14 weeks in young and older adults have revealed increases in cross-section area and thickness (hypertrophy) of the muscles. Muscle hypertrophy is the increase in the
cross-section of tissue due to a rise in the number (hyperplasia), or the size (hypertrophy) of muscle fibres (Franchi et al., 2018).

Earlier in a randomised controlled trial conducted by Kannabiran et al., who studied the efficacy of functional strength training in improving gross motor function among the children with spastic diplegic CP. The results of this study showed improvement in gross motor function after ten weeks of functional strength training program (Kannabiran and K, 2016).

Our study is also consistent with the research done by Vanessa A Scholtes on Lower limb strength training in children with cerebral palsy and concluded that an individualized, but group and school-based, functional PRE training will strengthen the lower limbs, and will accordingly lead to functional improvements in gross motor function and walking ability in children with CP (Scholtes et al., 2008).

CONCLUSIONS

The result of the current study shows that the functional strength training shows better improvement and potential to have an impact on the gross motor functional score as well as the functional independence in patients with spastic hemiplegic cerebral palsy. The statistical results show and support the above notion (i.e.) improvement in gross motor function in particular standing, walking, running and jumping after ten weeks of functional strength training program.

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Conflict of interest

There were no conflicts of interests between the authors during the elaboration of this paper.

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