

Original Research Article

Effects of lower limb strength training on gross motor functions in children with cerebral palsy

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ABSTRACT

Background: In cerebral palsy children muscular performance may be compromised by deleterious, changes in muscle tissue properties and co-activation of antagonist muscle strength. Resistance training has become an increasingly common intervention aiming to improve function by increasing muscular strength. So, the objective of the study was to evaluate the effect of strength training with Theraband on functional activities of cerebral palsy children by using Gross motor functional measurement (GMFM) scale.

Methods: The experimental study was done on 12 cerebral palsy children who fit under study criteria. The strength training was given 3 times in a week for 6 weeks by using Theraband as resistance training.

Results: The results of the present study show significant difference ($P < 0.005$) in pre and post score of GMFM component D and E after strength training. Also, there is 9.49% improvement in GMFM component 'D' and 6.39% improvement in component 'E' post treatment.

Conclusions: There is an improvement in gross motor function in particular standing, walking, running and jumping after 6 weeks of functional strength training program in children with cerebral palsy.

Keywords: Cerebral palsy, GMFM, Strength training, Theraband

INTRODUCTION

Cerebral palsy (CP) describe a group of permanent disorder of the development of movement and posture causing 'activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain.¹

Nevertheless, children with CP may present with a variety of motor disorders (e.g. poor co-ordination, loss of selective motor control), orthopaedic problems and other associated conditions (e.g. disturbances of

cognition).² Epidemiological studies, performed in developed countries, show the prevalence of 1.5 to 2.5 for each one thousand births.³ Alterations of the reflexes and muscle tonus are neurologic sequels commonly found at CP which change directly both the movement as well as the posture control. This clinical Picture, in a short time, leads to structural and morphological alterations of the musculoskeletal system, such as muscle contractions and bone deformation.¹

Possible factors interfering with normal gait pattern in CP include spasticity, muscle contractures, bony deformities,

loss of selective motor control, and muscle weakness. Recent review has shown that low muscle strength, and not spasticity, causes the greatest limitations in motor function in children with CP, and this has shifted the focus from spasticity management towards strength training for these children.⁴

Several studies of different methods for muscle strength training show that it is possible to increase muscle strength in children with CP. The influence of muscle strength training on walking ability has been reported as an increase in the Gross Motor Function Measure scores (GMFM).⁵

To be successful, strength training must be individualized, and should involve a progressive increase in intensity, thereby stimulating strength gains that are greater than those associated with normal growth and development (i.e. "overload").⁶ This is known as Progressive Resistance Exercise (PRE), and for this type of exercise any method can be used to bear, overcome or resist force, such as body weight, Theraband, free weights or machines.⁷

The Theraband are incredibly cost-effective, adaptable for multiple fitness levels. It is important to understand the progressive loss of the muscle strength, as this, together with spasticity, interferes directly with the motor rehabilitation strategies. The capacity the patient with CP has to generate strength is rarely evaluated and quantified, and consequently prioritized to the goals of a treatment.⁸ However, some difficulties can arise when measuring the strength of children with CP, such as the capacity to understand and accomplish repeatedly the production of maximum effort, besides the variations of posture tests and coupling of the measuring equipment, usually a dynamometer.⁹

The motor function is intrinsically connected to the capacity to generate strength and can be measured through functional scales, among which the most often used is the evaluation instrument denominated Gross Motor Functional Measure (GMFM), that is used in eighty-eight motor activities to achieve a numerical result corresponding to the percentage hit made by the patient. Efforts have been made aiming to understand how much the capacity to generate strength is connected with the functional capacity.¹

METHODS

The approval of the study has been taken from the institutional ethical committee. This experimental study was done in the physiotherapy OPD of the Dr. D Y Patil college of physiotherapy in Pune. Procedure started from the assessing the subject. The cerebral palsy child diagnosed by pediatrician has been examined by therapist. Total 12 Subjects (5 children were hemiplegic and 7 were diplegic cerebral palsy) fulfilling the inclusion criteria were taken for the study.

Inclusion criteria

- The CP child with GMFCS Level I and II
- CP child with age between 4-10 years
- Cerebral palsy without mental retardation (MR)
- GMFCS level I and II able to follow instructions.

Exclusion criteria

- CP children had undergone for Orthopaedic surgery of lower extremities in the past 12 months
- Botulinum toxic type A (Botox) injections in the past 6 months
- Serial casting in the past 6 months
- The CP children having insufficient cognitive understanding to comply with the assessment procedures and training program
- Spastic Quadriplegic type of cerebral palsy.

Brief information about the Physiotherapy is given to the children's parents/guardian with the consent form. The range of motion of all lower limb joint has taken with universal goniometer. The tone of all lower limb muscles is checked by Modified Ashworth Scale. GMFCS and GMFM has been taken in every participant and pre-treatment and post treatment.



Figure 1: Hip flexors strengthening exercises.



Figure 2: Hip extensors strengthening exercises.



Figure 3: Hip abductors strengthening exercises.



Figure 4: Hip adductors strengthening exercises.



Figure 5: Knee flexors strengthening exercises.

According to the GMFCS level resistance training was started with the low-resistance bands. (Theraband yellow, red and green) as the strength is increased in children resistance band colour was also changed with high resistance band. The strength training was given to the lower limb muscles like hip flexors-extensors, abductors-adductors, knee flexors-extensors and ankle dorsiflexors-

plantarflexors. Gross motor function was tested with GMFM domains D: standing, and E: walking, running, and jumping.



Figure 6: Knee extensors strengthening exercises.



Figure 7: Ankle Plantarflexors strengthening exercises.



Figure 8: Ankle Dorsiflexors strengthening exercises.

The training period lasted for 6 weeks, three times a week at clinic. Individual programme with three sets of 10 repetitions for each muscle group: first set easy, second medium, and third with a heavy Theraband-10 repetition maximum (10RM). Resistance was provided by

resistance band. Resistance was increased during the training period when the children could do more than 10 repetitions with the 10RM.

RESULTS

Total 12 cerebral palsy children were trained with strengthening programme in duration of September 2017 to February 2018. Descriptive statistics was conducted for mean age and gender of cerebral palsy children. Paired t-test was used for comparison between pre and post treatment mean values of GMFM-88- components D, E, total and goal area.

Table 1: Distribution of type of cerebral palsy children.

Type of cerebral palsy	No. of children	%
Spastic hemiplegic	5	42
Spastic diplegic	7	58

Table 1 shows that spastic diplegic CP children are 58 % which is more than spastic hemiplegic that is 42%.

Table 2: Distribution of CP children according to GMFCS level.

GMFCS level	No. of children	%
I	10	83
II	2	17

Table 2 shows that 17% of children have GMFCS level I and 83% of children have GMFCS level II.

Table 3: Comparison of pre and post mean score of GMFM-88.

GMFM-88	X±SD		P-value
	Pre	Post	
D	68.713±19	78.201±18.1	0.001065
E	62.633±23.646	69.024±24.11	0.004378
Total	78.4±11.057	85.015±11.3	0.000739
Goal	65.719±20.64	73.613±20.8	0.001138

Figure 9 shows that the P value for all D, E, goal area and total score of GMFM is <0.005. So, there is significant improvement in GMFM component ‘D’ and component ‘E’ after strength training to the CP child.

After finishing the pretest assessment, the calculated mean pretest score of dimension ‘D’ was 68.71 %. After the 6-week intervention program the post-test scores were measured and the mean value of the post test score was 78.20%. So, there was 9.49% increase in the dimension D (standing) of gross motor function measure due to 6-week functional strength training.

In dimension E (walking, running, jumping) the assessment mean pre-test score was 62.63 % and the

post-test mean score was 69.02% and p value for both (D, E) is <0.05.

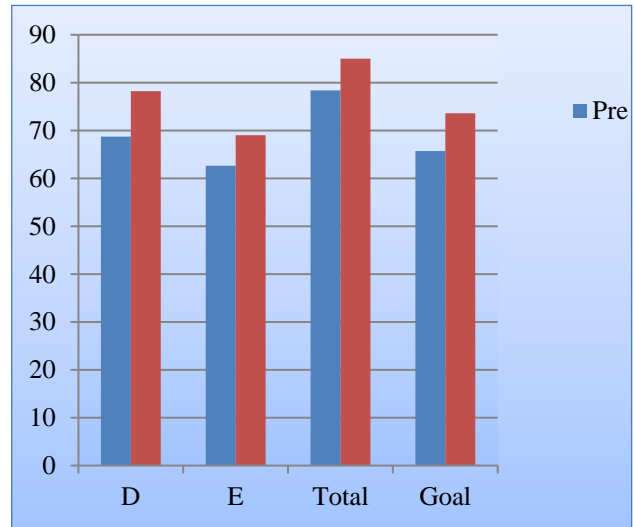


Figure 9: Comparison between pre and post mean score of component D, E, Goal area and total score of GMFM 88.

By these we found that there was significant improvement in walking, running, and jumping up to 6.39%, which shows that there is increase in balance after the functional strength training. Therefore, from the above analysis we could found the significant changes in overall gross motor function after 6 weeks functional strength training in the children with cerebral palsy.

DISCUSSION

An experimental study was done in Dr. D. Y. Patil Physiotherapy OPD was done. Sample age group was 4-10 years and sample size were 12 out of which 8 samples were males and 4 were females.

GMFM scores increased at group level, items that showed changes were most often standing on one leg, step up and step down and stair climbing with alternate foot without support. The ability to balance on one leg is very important for many tasks in everyday life, such as negotiating obstacles and climbing stairs. Reduction in antagonistic co-contraction improves gross motor function and also enhanced muscle performance: restoration, improvement, or maintenance of muscle strength, power, and endurance.¹⁰

Kannabiran B in 2016, conducted similar study on gross motor function abilities of hemiplegic and diplegic cerebral palsy children, which concluded that there was significant improvement in the post treatment evaluation and also gross motor function of cerebral palsy children is less than functional abilities of children with typical development.¹¹ Morton JF in 2003 has done the similar study which shows that there is decrease in muscle tone, improvement in standing (D) and walking, running, and

jumping (E) goal areas of the gross motor function measure and walking speed and step rate has been increased. The most common adaptation to heavy resistance exercise is an increase in the maximum force-producing capacity of muscle strength, primarily as the result of neural adaptations and an increase in muscle fiber size.⁶ Schwarze DJ, Denton JR had also found that there was no difference between right and left values of lower limb joints as well as boys and girls had essentially the same values.¹² There was very less increase in range of motion in all lower limb joint. We found that there is 3.3% improvement in hip flexion and only 0.95% improvement in hip extension. The improvement in hip abduction is 0.1% and hip adduction is 1.55% after the 6 weeks of functional training. There are no changes seen in knee flexion and extension after the treatment. In ankle plantar flexion there is an improvement of 1.65% and improvement in ankle dorsiflexion is 1.55%. Due to spasticity there was very less improvement seen in range of motion of the cerebral palsy children.

After assessment of post-treatment, there are no changes seen in spasticity. This is due to shortening of the muscles and distal muscle weakness. Limitations of this study were the site of administration for the vaccine to be given was abdomen 91 (65.9%), buttocks 22 (15.9%), shoulder 18 (13.04%), thigh 2 (1.4%), don't know 5 (3.6%).

CONCLUSION

The statistical results show that there is an improvement in gross motor function in particular standing, walking, running and jumping after 6 weeks of functional strength training program in children with cerebral palsy.

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Conflict of interest: None declared

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