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EFFECTIVENESS OF PROGRESSIVE RESISTANCE TRAINING IN SPASTIC DIPLEGICS

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Abstract:

Spastic diplegia is the most common form of cerebral palsy and it is characterized by greater involvement in the lower extremities than in the upper extremities. The objective of this study was to find out the effectiveness of Progressive Resistance Trainingin children with spastic diplegicsin improving self selected gait velocity and gross motor function.

Methodology:

The Study design was Experimental design.18 diplegic cerebral palsy subjects in the age group of 5 to 12 years were studied for period of 5 weeks .They were divided into 2 groups, Group A and Group B.Gross Motor Function Measurement and Timed 10-Meter Walk Test were used as the outcome measures.

Results:

There was significant difference of progressive resistance training in children with spastic diplegics in improving self selected gait velocity and gross motor function($P<0.005$). The mean and S.D value of Group A was 92.21,6.7(GMFM). The mean and S.D value of Ten Meter Walk Test of Group was .9 and .3(TMWT).

CONCLUSION: This study concluded that free-weight progressive resistance training can be viewed as an accessible, practical and safe method to increase GMFM and positively alter walking ability in spastic diplegics.

Key words: spastic diplegics, progressive resistance training, GMFM, TMWT.

Introduction

"Cerebral Palsy (CP) is a group of conditions characterized by motor dysfunction due to non-progressive brain damage early in life", affecting approximately 1- 2 per100live births(1).The topographical classification frequently used are as follows, quadriplegia, diplegia, paraplegia, triplegia, monoplegia(2). Strength training has been regarded as controversial and inappropriate, due to concerns that it would increase abnormal muscle tone and movement abnormalities (3).Nevertheless, some studies have shown that strength gains can be achieved in children with cerebral palsy, without adverse effects(4). Because of impairments such as weakness, spasticity, and in coordination, many people with cerebral palsy have difficulty with activities such as propelling their wheelchairs, walking independently, negotiating steps, and running or navigating safely over uneven terrain(5). Spastic diplegia is the most common form of cerebral palsy and it is characterized by greater involvement in the lower extremities than in the upper extremities. The imbalance of muscle strength and tone causes muscle weakness and atrophy overtime, as well as soft tissue contracture and eventual joint deformity(6). Strength training is a very popular form of training among both adults with and without disabilities but until recently it has not been recommended for individuals with cerebral palsy. Our clinical experience is that adults with cerebral palsy often ask for training that is effective and also easily available in society.

Mc Cubbin and S has by has done a randomized controlled trial described a significant increase in movement speed and muscle torque in the resistance trained group with no adverse effects(7). Many systematic review has been published that examined the effects of strengthening in this population . Other authors reported that gains in strength could be achieved with resistance training of lower limb musculature for cerebral palsy without adverse effects on movement or spasticity(8).

A recent review has shown that low muscle strength, and not spasticity, causes the greatest limitations in motor function in children with cerebral palsy, and this has shifted the focus from spasticity management towards strength training for these children(9).

This study aimed to investigate the effects of progressive resistance training in lower limb muscles including hip flexors, extensors, abductors, knee flexors, extensors and an kledorsiflexors and plantar flexors regard with functional outcomes in spasticdiplegiccerebral palsy.

The objective of this study was to find out the effectiveness of Progressive Resistance Training in children with spastic diplegicsin improving self selected gait velocity and gross motor function. The importance of this study is to increase functional activity and improve walking pattern in spastic diplegics cerebral palsy by giving progressive resisted exercises in lower limb musculature in diplegics.

Methodology

The Study design was Experimental design and simple random sampling method was used. Instructional Ethical Committee approval obtained from our institution. Informed consent was optained from parents.18 diplegic cerebral palsy subjects in the age group of 5 to 12 years were studied for period of 5 weeks in Maithree special school, Tambaram Chennai& K K, Nagar Chennai (Tamil Nadu).Gross Motor Function Measurement was used as the outcome measure. The GMFM is a standardized observational instrument designed and validated to measure change in gross motor function over time in children with cerebral palsy. The scoring key was meant to be a general guideline.

However, most of the items have specific descriptors for each score. It is imperative that the guidelines contained in the manual be used for scoring each item(10-12).The standing (D) and walking, running and jumping (E) goal areas of the Gross Motor Function was measured by asking the patients to complete the goals.

Timed 10-Meter Walk Test:children made to walk on plane surface in comfortable speed with or without walking assistance devices and the time is measured for the intermediate 6- meters to allow for acceleration and deceleration(13,14).

Surgical or orthopedic procedure during or up to six months prior to the study, Medication changes that could affect muscle strength or tone and children those who areunder anti epileptic therapy, Any cardiac or respiratory conditions that may be affected by exercise, Deformities in lower limb, Moderate and severe mentally retardation were excluded from study.

25 children with spastic diplegics were taken, then by randomization only 18 were selected for this study, after they met up all the inclusion criteria and was divided into two groups after filling up the consent form by the parents or care givers. Group A– Experimental group of 9 subjects. Group B– Control group of 9 subjects. Both the groups received conventional physiotherapy. Along with this, Group A received Progressive Resistance Training. Pre test score was taken before the study and post test score was taken after 5 weeks of the study. The outcome measures were Gross Motor Function Measure and 10 meter walk test.

Progressive Resistance Training intervention – Standard De Lorme and Warkinsprotocol(15-17).The Volume of exercises were8 repetitions of 3 sets,Frequency 3 times a week with one day rest between sessions,Duration 5 weeks, Rest interval **was**1 to 2 minutes,Mode of exercise wasWeight cuff ,Selection of weight **-** 8RM,Progression **was** at the end of every week check for new 8 RM.The collected data were tabulated and analyzed using descriptive and inferential statistics.

To find out the changes in “Gross Motor Function and ten meter walking test” from pre test to post test, paired‘t’ test and Independent ‘t’ test were used.

Table -1 Progressive Resistive Training.

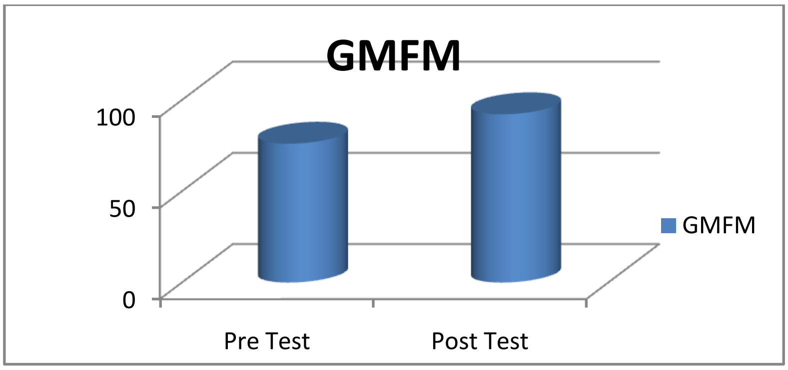
Muscles		Patient position	Tie the weight cuff
HIP	Extensors	Prone lying	Ankle
	Flexors	Supine position	Ankle
	Abductors	Side Lying	Ankle
	Adductors	Side Lying	Ankle
KNEE	Extensors	High sitting	Ankle
	Flexors	Prone Lying	Ankle
ANKLE	Dorsiflexors	High sitting	Fore foot
	Plantar flexors	Prone lying with knee 90° of Flexion	Fore foot

Table-2: Pre and Post Test Values of Gross Motor Function Measurement Scale And 10 Meter Walking Test of Group A.

Group-A	Pre Test		Post Test		t-value	Significance (P)
	Mean	SD	Mean	SD		
GMFM	76.0944	8.33829	92.2100	6.74912	7.703	0.000
10 M WALK	0.5811	0.16541	0.9689	0.31386	4.964	0.001

This table 2 shows the pre test mean value of gross motor function measurement scale of group A was 76.0944 and post test value was 92.2100. The pre test mean value of ten meter walking test was .5811and post test mean value was 0.9689.In this table, there is a statistically significant difference in group A between pre test and post test at **p <0.005.**

Graph 1: Graphical Representation of Pre and Post Test Values of Gross Motor Function Measurement Scale And 10 Meter Walking Test of Group A.



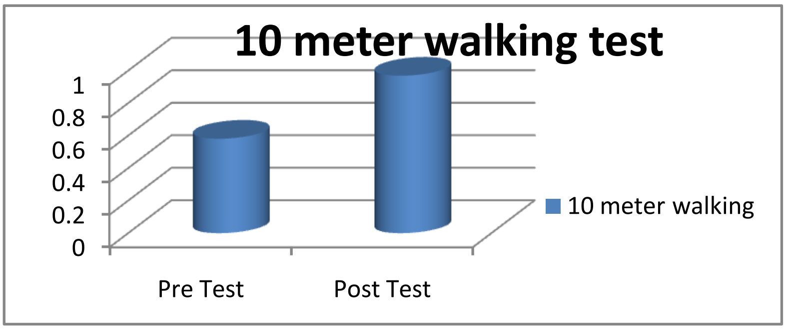
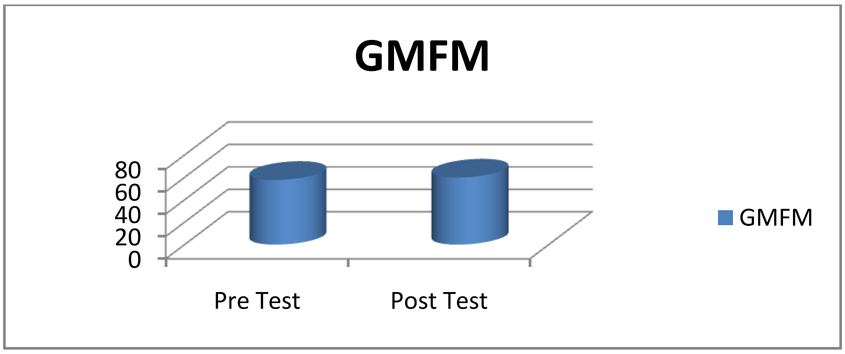


TABLE – 3: Pre and Post Test Values of Gross Motor Function Measurement Scale And 10 Meter Walking Test of group B

Group-B	Pre Test		Post Test		T value	Significance (P)
	Mean	SD	Mean	SD		
GMFM	57.7000	21.28719	59.8322	20.76551	8.715	0.000
10 M WALK	0.5533	0.44387	0.6533	0.47610	4.009	0.004

Thistable 3 shows, the pre test mean value of gross motor function measurement scale of group B was 57.7000 and post test value was 59.8322. Andthepre test mean value of ten meter walking test was 0.5533 and post test mean value was 0.6533. In this table, there is a statistically significant difference in group B between pre testandpost test at **p <0.005**

GRAPH 2: Graphical Representation of Pre And Post 10 Values of Gross Motor Function Measurement Scale And Ten Meter Walking Test Of Group B.



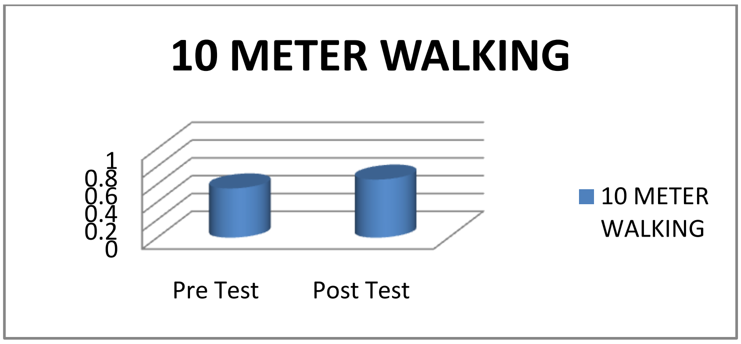


Table-4: Post Test Values of Gross Motor Function Measurement Scale For Group A And Group B.

Post Test Values	Mean	S.D	t- value	Significance
Group A	92.2100	6.74912	4.449	0.00
Group B	59.8322	20.76551	4.449	0.00

The table 4 shows ,the post test mean value of gross motor function measurement scale of group A was 92.2100 with standard deviation of 6.7491 and post test mean value of gross motor function measurement scale of group B was 59.8322 with standard deviation of 20.7655. In this table 3,**p<0.05**, there is a significant difference between Post-test values of GMFM in Group A and Group B subjects but group A is more statistically significant than Group B.

GRAPH 3: Graphical Representation of Post Test Values of Gross Motor Function Measurement Scale For Group A And Group B.

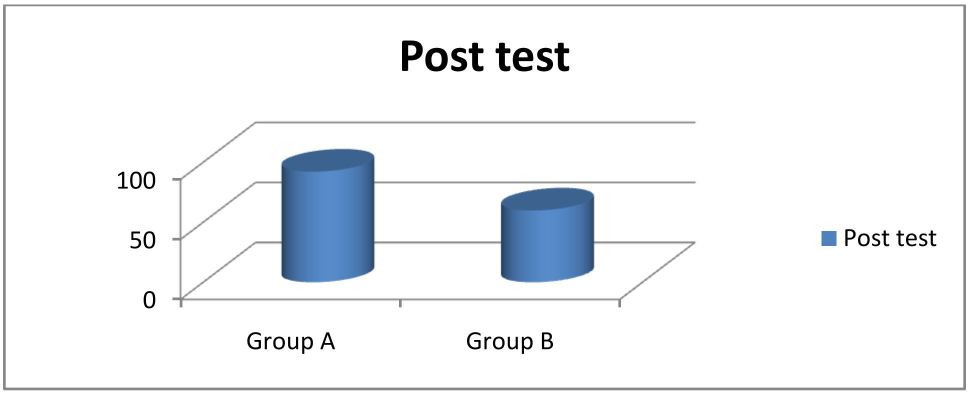
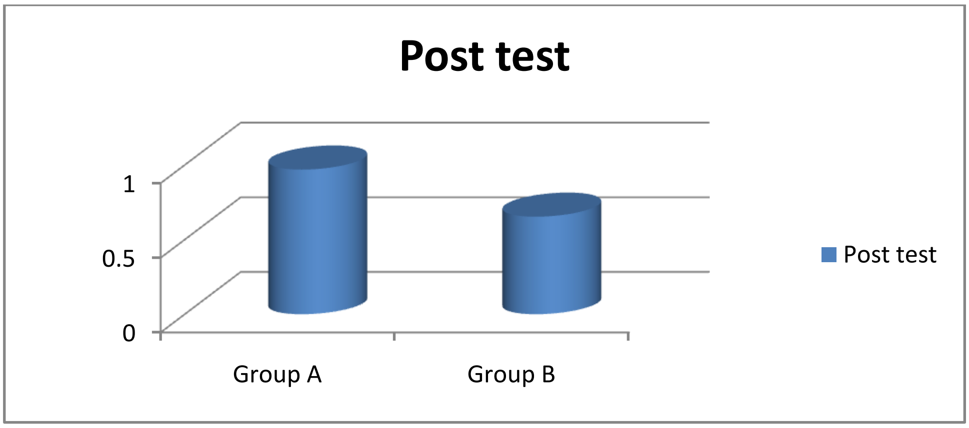


Table-5: Post Test Values of 10 Meter Walking Testing Group A And Group B.

Post Test Values	Mean	S.D	t- value	Significance
Group A	0.9689	0.31386	4.964	0.001
Group B	0.6533	0.47610	4.009	0.004

This table 5 shows, the post test mean value of ten meter walking test was 0.9689 for group A with standard deviation of 0.31386 and post test mean value of ten meter walking test was 0.6533 for group B with standard deviation of o.47610.In this table 4, **p<0.05**, there is a significant difference betweenPost test values of ten meter walking test in Group A and Group B but group A is more statistically significant than Group B.

GRAPH 4: Graphical Representation of 10 Meter Walking Test In Group A And Group B.



Discussion

The objective of this study was to find out the effectiveness of Progressive Resistance Trainingin children with spastic diplegicsin improving self selected gait velocity and gross motor function.In this study, it was observed that there was significant difference of progressive resistance training in children with spastic diplegics in improving self selected gait velocity and gross motor function.

The children enjoyed exercising and there were no reports of joint discomfort. Resistance training appeared appropriate and safe and is in agreement with findings in similar studies(18,19).Teixeira-Salmela LFconcluded that “muscle strengthening and physical conditioning is very useful to reduce impairment and disability in cerebral palsy”(20,21).

The neurophysiological adaptations to a strength-training protocol in children with cerebral palsy are Increased muscle activation (EMG),Reduced co-activation of antagonist muscles, greater activation of synergist muscles, increasing spinal cord connections, motor unit synchronization, Cross education Bilateral effect(22).

Fowler EG et alconcluded that “quadriceps femoris muscle strengthing exercises improves crouch gait walking in children with cerebral palsy”(23).Neural changes continue with training, helping to achieve movement. This phase is more beneficial for Cerebral Palsy than the hypertrophy phase. Once the neurological "learning" phase begins to diminish, remodeling of the muscle is beginning to take place and strength gains continue(24).Abel MF et al concluded that “strength training improves functional outcomes in children with cerebral palsy”(25).

The muscular adaptations to a strength-training protocol in children with cerebral palsy are muscle hypertrophy, muscle fiber type transitions, alternations to muscle architecture. Hypertrophy is the increase in muscle size as a result of an increase in either the number of muscle fibers in a group (hyperplasia), or the size of individual muscle fibers (hypertrophy). Research confirms hypertrophic changes in muscles of cerebral palsy patients(26,27). Muscle strengthening and physical conditioning is very useful to reduce impairment and disability in cerebral palsy(28).

Children with Cerebral palsy generally lead a very sedentary lifestyle. The muscles undergo structural changes related to their lack of activity. Type I muscle fibers change their structure to Type II. The result is most prominent in large groups of postural muscles. Children with Cerebral Palsy need Type I fibers to control posture and stabilize the body to perform daily functions(29).Current studies show that proper training can induce fiber-type alternation. Fast-twitch fibers might become more oxidative with training(30).

However, in this study it was observed that along with the conventional physiotherapy, resistance training is useful for children with cerebral palsy, resistance training increase the muscle strength in spastic diplegics.Tempelaars et alconcluded that "pediatric endurance and limb progressive resistive strengthening exercises improve Stationary cycling in children with cerebral palsy''.Sung IY et alconcluded that "gait function can be improved in children with diplegic cerebral palsy by progressive resistive exercises"(30)

In this study base line pre test values were not taken similarly for both group and sample size is less so this needs to be corrected for further study. And this study, muscles strength was not checked so the results should be viewed with caution.It was inferred from the study that progressive resistive exercise increased the muscle's strength but not spasticty in children with cerebral palsy and enhance their gross motor function and self selected velocity.This study was in agreement with others, who reported statistically significant GMFM and self selected velocity gained aftertraining(29).

Recommendations of this study are, study can be done with larger sample size., study duration can be increased, compare the effects on sex difference, effect of progressive resistive exercise on spasticity and muscle strength can be evaluate andthis study can be done for spastic hemiplegics.

Conclusion

Thus the results of this study concludedthat free-weight progressive resistance training can be viewed as an accessible, practical and safe method to increase GMFM and positively alter walking ability in spastic diplegics.

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