Original Article

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Correlation between Spasticity and Balance in Children with Diplegic Cerebral Palsy

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Abstract

A total of 22 subjects were selected from various cerebral palsy rehabilitation center of Dehradun and met the inclusion criteria were included in the co-relation study. An informed consent of subjects was taken from 22 subjects. Parent had been informed about the purpose and procedure of study and informed consent was obtained. All subjects were evaluated for spasticity, balance and gross motor activity. The data was analyzed finally to find the correlation between spasticity and balance and also between spasticity and gross motor function. The results shows that mean spasticity of knee flexor of both the lower limbs relates fairly with pediatric balance scale (r=-0.433) whereas mean spasticity of plantar flexor shows good negative relationship with pediatric balance scale (r=-0.616) which means that planter flexor spasticity affects balance more than knee flexor spasticity. In our study result showed moderate correlation between average MAS score of both limb and GMFM score. Thus our results suggest that spasticity limit functional performance in a biomechanically predictable fashion in children with cerebral palsy.

Keywords: Spasticity; Gross motor function; Pediatric balance scale.

Introduction

Cerebral palsy is a non-progressive disorders resulting in an abnormal development of movement [1]. Cerebral palsy presents with various types of disorders such as spasticity, low muscle strength and improved motor control. One of the key problem in children with cerebral palsy is deficient postural control [3]. The impairment of balance in these children is due to the impairment of motor control, tone, vestibular system, visual and sensory system, thus postural control requires a complex interaction between systems, such as musculoskeletal and neural system [5]. Research by Nasher et al have shown that a number of factors contribute to poor reactive balance control in this population ; these include spasticity, muscle weakness, excessive co-contraction of agonist muscles at a joint and increased stiffness [6]. On the previous studies had also postulated that the main impairment in postural control is lack of descending inhibition of spinal reflexes due to damage in higher cortical center. This allows primitive reflexes to dominate postural control, resulting in spasticity [6]. Abnormal muscle tone is the most common motor abnormalities that occurs in cerebral palsy. Spasticity has been characterized in a variety of ways including muscles, hypertonia, hyper active deep reflexes and clonus [12-14]. Spasticity is considered to be main problem in cerebral palsy [14]. Spastic diplegia is the most common form of CP, and it is characterized by greater involvement in lower limb than in upper limb [8]. In clinical practice spasticity is assessed as a velocity – dependent increased resistance to passive muscles stretch. The modified Ashworth scale, which grades resistance to passive stretch, has gained widespread acceptance as a clinical tool [10], and is also frequently used to document the effect of medication and surgery on spasticity in children with CP [2,11].

There are many functional effects of spasticity; in some children it causes major problems in ambulation. Spasticity causes typical spastic gait patterns. The presence of spasticity in the lower extremity musculature of children with spastic

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diplegia has been thought to be a contribution factors to there limitation in standing balance and walking function [4]. Balance requires a complex interaction of musculoskel et al. and neural system [5]. A pilot study done on two subjects showed that creating a functional position reduces spaticity and enhances postural control [22]. Move over, children with cerebral palsy showed temporal reversals among the muscle responding to aloss of balance, in addition to high level of agonist and antagonist muscle co-activation [6].

Pediatric balance scale was developed as a balance measure for children with mild to moderate impairment. The PBS has been demonstrated to have good test –retest (ICC= 0.998] and Interrater reliability (ICC=O.997) [20M].

The Gross Motor Function Measures (GMFM) is a criterition-reference observational measure that was developed and validated to assess children with cerebral palsy(CP). The GMFM-66 provides a better understanding of motor development for the children with CP than the 88- items GMFM. Test-retest reliability was prove to be high i.e. interclass correlation coefficient is 0.99 [15].

Although various factors have been thought to be the contributing factors for balance impairment in this population but there is a little literature which suggest any relation between spasticity and balance in diplegic cerebral palsy population.

Methodology

Sample

A total of 22 subjects participated in the the study. The study was conducted in various cerebral rehabilitation centers in Dehradun.

Study Design

Correlation study

Inclusive Criteria

1 Diagnosed spastic diplegic children.
2 Ability to stand independently for 5 min.
3 Both male and female.
4 Age between 5-15 years.
5 Ability to follow simple commands.

Exclusive Criteria

1 Child with any surgical history of lower limb.
2 Botox therapy within last six month.

Instrumentation and outcome measures

Pediatric Balance Scale: Shows good test –retest (ICC=0.998) and Interrater reliability (ICC= 0.997)

- Stopwatch
- Footstool or step
- Chair of appropriate height (one with arm rests, one without)

Modified Ashworth Scale: shows good interrater reliability for knee flexors (ICC=0.76) and plantar flexors (ICC= 0.64), whereas intrarater reliability for knee flexors (ICC=0.64) and plantar flexors (ICC=0.43).

Gross Motor Function Measure: It is widely used scale for assessment of gross motor function in cerebral palsy population.

Protocol

Based on inclusive and exclusive criteria 22 subjects were included in the study. Subject were assessed for spasticity, balance and gross motor using modified Ashworth scale, Pediatrics balance scale and Gross motor function measures respectively.

Procedure

Participants were selected from various cerebral palsy rehabilitation centers from Dehradun. The subjects were chosen as per the inclusion and exclusion criteria. Parent had been informed about the purpose and procedure of study and informed consent was obtained.

All subjects were evaluated for spasticity, balance and gross motor activity. The data was analysed finally to find the correlation between spasticity and balance and also between spasticity and gross motor function.

Spasticity Assessment

Spasticity of the lower limb muscles groups that are most found in diplegic cerebral palsy children are Knee flexor and planter flexor were assessed using Modified Ashworth scale (MAS). For the Assessment of spasticity in Knee flexor subject position was in prone position and examiner standing aside of the limb being assessed, one hand stabilizing the pelvis while other hand holding the ankle fast repetitive passive movement was performed. Spasticity was graded according to MAS.

Similar procedure was followed while assessing the plantar flexor spasticity but the subjects position was in supine lying position and therapist holding the proximal end of ankle joint where as other hand holding forefoot.

Balance

To evaluate the ability to maintain balance of cerebral palsy child we used Pediatric Balance Scale (PBS), a modification of Bergs Balance Scale. All the children were provided by proper instruction before documenting each task and precaution is taken for risk of fall. Rest is given in between the collection of data.

Gross Motor Function

Gross Motor function of children was assessed using dimension E i.e. walking running, jumping domain of gross motor function measures -66 (GMFM-66). Zero score is assigned to any items omitted or which the child is unable to perform. In the GMFM, function is defined in terms of the child s ability to perform a given motor task upon instruction in a specific test situation. Before collecting the data each component is explain properly, demonstrated where ever it is needed and precaution is taken for any risk of fall and rest is given in between the procedure.

Obtained data is analysed for relationship between spaticity, balance and motor function.

Result

Mean age was analysed for 22 participants. Mean age of participants was 8.31 3.45 yr where maximum age is 15 yr and minimum age is 4 yr.

Table 1: Descriptives of PBS and spasticity (MAS)

	Mean SD	Maximum	Minimum
PBS	37±7.7	50	27
RT knee flexor spasticity	2.27±0.59	3	1+
LT Knee flexor spasticity	2.18±0.54	3	1+
RT Ankle plantar flexor spasticity	2.34±0.58	3	1+
LT Ankle plantar flexor spasticity	2.09±0.47	3	1+
Mean knee flexor spaticity	2.20±0.43	3	1.5
Mean Ankle plantar flexor spaticity	2.21 ±0.45	3	1.5
Mean knee and plantar flexor spasticity	2.21±,34	2.25	1.62

Table 2: Relationship between spasticity and pediatric balance scale(PBS)

Relation between	Correlation coefficient(r)	P value
RT knee flexor spasticity and PBS	-0.38	.040
LT Knee flexor spasticity and PBS	-0.416	.027
RT Ankle plantar flexor spasticity and PBS	-0.431	.023
LT Ankle plantar flexor spasticity and PBS	-0.623	.01
Both knee flexor mean spasticity	-0.433	-.022
Both plantar flexor mean spaticity	-0.616	-.01
Mean of both knee and plantar flexor spasticity and PBS	-0.642	-.001

Table 3: Descriptives of spasticity (MAS) and GMFM (Dimension E)

	Maximum	Minimum	Mean± SD
Mean of both Ankle and Plantar Flexor S	2.25	1.65	2.21±0.34
GMFM (Item E)	86.11	33.33	64.28±15.77

Discussion

In our study we aim to investigate the relationship of spasticity with balance and gross motor function in children with diplegic cerebral palsy. Our results indicate that there is a statistically significant, weak to good, negative relationship between spasticity and balance.

Relationship between Spasticity and Balance

The results shows that mean spasticity of knee flexor of both the lower limbs relates fairly with pediatric balance scale (r=-0.433) where as mean spasticity of plantar flexor shows good negative relationship with pediatric balance scale (r=-0.616) which means that planter flexor spasticity affects balance more than knee flexor spasticity. That might be because typically developing children use more of ankle strategies than children with diplegic cerebral palsy and also it has been shown that if children are not in an upright position there are chances that they will not generate ankle strategy [21]. The ankle strategy restore the COM to a position of stability through body movement centered primarily about ankle joint where as to use the ankle strategy it required intact range of motion [5]. This could be reason that in our study plantar flexors spasticity showed greater negative correlation than knee flexors spasticity with pediatric balance scale.

The average spasticity of both knee flexors and plantar flexors showed good negative relation with

pediatric balance scale (r=-0.642). Children with diplegic cerebral palsy show restricted range of motion in many joints, including the ankle, knee and hip. Contracture of hip, knee and ankle muscles results in atypical postures in sitting and standing so there will be abnormal alignment of the body segment. Abnormai alignment can reflect change in alignment of the body segment. Abnormal alignment can reflects change in alignment of the center of mass relative to the base of support [5]. Some authors believe that increased muscles tone produces an antagonist co-contraction [6]. This co-contraction creates resistance to passive movement and limits active movement, resulting in abnormal movement patten [17].

Yang in 1996 investigated the difference of sitting balance before and after selective posterior rhizotomy which gives strong evidence to our study that reduction in spasticity will improve balance [16].

In our study spasticity showed weak to good correlation with balance. This could be because balance requires complex interaction of musculoskeletal and neural system. Neural component essential for balance are neuromuscular connection, sensory processes, including the visual, vestibular and somatosensory system and high level integration process [5].

Pediatric balance scale was developed as a balance measure in pediatric motor impaired population. PBS includes interaction of upper body and trunk also, were as we have included the spasticity of knee flexor and plantar flexor only., where as spasticity in other muscles and upper body impairement were included which might also have an impact on impaired balance. Moveover PBS has its floor and ceiling effects.

Relationship between spasticity and Gross Motor Function

In our study result showed moderate correlation between average MAS score of both limb and GMFM score. Thus our results suggest that spasticity limit functional performance in a biomechanically predictable fashion in children with cerebral palsy. There has been considerable controversy regarding the extent to which spasticity contributes to activity limitation in children with cerebral palsy [10].

Ostensjo et al. (2004) found in there study that spasticity (MAS), ROM, and selected motor control inversely relates to gross Motor function. Multivariate analysis revealed that selective motor control was the strongest predictor of these three impairment. They assumed that impairement in voluntary movement also be related to spasticity [9].

In our study there is moderate relationship between spasticity and gross motor on the contrary previous studies showed weak to fair relationship [18].

Spasticity should be objectively measured pre and post intervention to clarify the relationship between impairment and function and how changes with regard to different intervention.

Conclusion

We conclude from our study that, in children with diplegic cerebral palsy with increase in spasticity there is reduction in balance and motor function. So spasticity is one of the factor responsible for impaired balance and function in diplegic cerebral palsy.

Clinical significance

In our study spasticity correlates negatively with both balance and gross motor function so spasticity has been a factor for impaired balance in diplegic cerebral palsy children. So spasticity reduction technique can be included as a treatment strategy for improving balance and function in diplegic cerebral palsy children.

Conflict of Intrest:

- Small sample size

- Balance can be measured by more sensitive tools like plate form.

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Ethical Clereance: It is a abonafide work done by me and I have not taken any part of the thesis from anywhere.

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