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Effect of Sensorimotor Exercises in Reducing Toe Walking in Autistic Spectrum Disorder

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ABSTRACT

Autism Spectrum disorder is defined as the global developmental disorder characterized by difficulty in social interaction and communication. It is manifested as repetitive patterns of thoughts and behavior. Toe walking is one of the most common initial signs exhibited by autism children and is mostly unilateral. The aim of this study was to identify the effect of Conventional Exercises and Sensorimotor Exercises in reducing the toe-walk in autism children. The study was a randomized control trial that included children of both sex between age group 2 & 5 years with a history of recent toe-walk. The subjects without a history of Tendo Achilles contracture and with a good hip flexibility were included. Subjects with a long time history of toe walking and with TA contracture and associated surgical corrections were excluded. Any subject with a diagnosis of Cerebral palsy and Asperger syndrome were excluded. A total of 40 subjects were included in the study who underwent assessment of Foot alignment through photographs, Plantar Foot Pressure through Foot Posture Index-6 and range of motion at ankle through Goniometer. Group A received Conventional exercises and Group B received Sensorimotor exercises for a period of 4 days a week for 8 weeks. At the end of 8th week a post test was done for all the standard tests used in the study. The result of the study shows that the experimental group (Group B) who received sensorimotor exercises showed significant improvement in Foot Alignment and range of motion of both plantar flexion and dorsiflexion while the Control group (Group A) showed improvement only in passive range of motion of dorsiflexion alone. The study helps to conclude that the group which received Sensorimotor exercises improved well. Hence it can be considered as the best of treatment to inhibit toe-walk in autistic children.

Key words: Autism, Autistic Spectrum Disorder, Toe Walk, Physiotherapy for Toe Walk, Sensorimotor exercises.

INTRODUCTION

Autism is a developmental disorder that affects the children at an early age of one but exhibits symptoms only around the age of three. The word is derived from a Greek word “auto” which means “self” and “ism” which means “state of being”. Hence autism on the whole means a state of being oneself. Generally autism is viewed as a source of disappointment, annoyance, shame or worse. The social stigma that the parents undergo prevents them from seeking diagnosis and medical services for the children. It also prevents them from participating fully in communities and enjoying same quality of life as that of others. But medically Autism should be considered as a variation of human condition. These children view the world with a different perspective at different pace. Patching up the difference in pace and perspective will re-create the space for these children in this world in a more meaningful way.

Autism Spectrum disorder is defined as the global developmental disorder characterized by difficulty in social interaction and communication. It is manifested as repetitive patterns of thoughts and behavior.[1] The term "spectrum" in autism spectrum disorder refers to the wide range of symptoms and severity. Autism, Asperger's syndrome, childhood disintegrative disorder and an unspecified form of pervasive developmental disorder all come under the spectrum of disorder. Autism spectrum disorder starts very early in life and becomes obvious when there is difficulty in social interaction either in school or in neighborhood. The symptom develops early at the age of one year, but undergoes a regression period from 18 to 24 months. This is the reason why many cases go unnoticeable.

Children with ASD frequently demonstrate significant differences in the ways that they respond to sensory stimuli.[2] Sensory modulation disorder can either be sensory over activity, sensory under activity or sensory seeking disorder. It is usually deficits in social-emotional reciprocity, ranging, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.[3] And also deficits in nonverbal communicative behavior used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.[4] Additionally deficits in developing, maintaining, and understand relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.[5]

Apart from sensory disorders autism children exhibit toe walking as an early motor symptom. Toe walking is a pattern of walking exhibited by children intentionally or unintentionally. The child raises the heel and tends to walk on toes or ball of toes. Absence of heel strike is noted. Toe walking is exhibited by many children when they initially start to walk. If exhibited beyond 2 years of age is a concern and needs medical attention. Persistence of toe walk in children beyond age of 2 can be sign of underlying conditions like cerebral palsy, muscular dystrophy or autism spectrum disorder.

Toe walking is one of the most common initial signs exhibited by autism children and is mostly unilateral. The incidence of persistent toe walking (20.1%) and tight heel cords (12.0%) were found to be higher in autistic spectrum disorder.[6] Toe walking is not only a sign of motor impairment but is actually an indication of both language delay and sensory integration dysfunction.[7] Hence a holistic approach to reduce the toe walking is necessary to bring initiation of speech and language center in autistic children and also to reduce sensory issues.

The pathophysiology of toe walking is attributed to a disorder of movement, muscle or posture caused by injury or abnormal development in the parts of the immature brain that controls the muscle function. As it increases the risk of falling and is considered a social stigma the treatment to normalize the tone of the calf muscle is vital. There are a variety of exercises for inhibiting toe walk. A physiotherapy exercise session addresses in normalizing the tone of the calf muscle and re-educating the muscle to function normally. These exercises are grouped under Conventional Physiotherapy Exercises which includes Passive exercises for ankle, foot and knee, range of motion exercises for ankle in ankle foot exerciser, Tendo Achilles stretching and Frenkel's exercise. Muscle stretching exercise programmes targeting gastrocnemius, soleus, or both has proven effective in reducing the toe walk.[8] This aims to lengthen the Achilles tendon, increase dorsiflexion of the ankle joint, and thereby facilitate a typical heel-toe gait pattern. The

Frenkel's exercises aims at motor control intervention to facilitate erect standing and walking posture, and to secure a ground reaction force relative to the ankle axis.[9]

MATERIALS AND METHODOLOGY

The study was a randomized control trial with one control group and one experimental group with 20 subjects in each group. The subjects of the study were children between the age group of 2 and 5 years of both sexes who were diagnosed for autism and with a history of toe walking either unilaterally or bilaterally, for more than three months were included in the study. The children with abnormal FPI - 6 score and without a history of hip contracture and good hip flexibility were included in the study. Children with a history of long term toe walking, TA contractures, any surgical correction for TA lengthening, associated mental retardation, CP and Asperger syndrome and children above the age of 5 were excluded from the study.

The purpose and nature of the study was briefed to the parents/attenders and an informed consent was obtained prior to the inclusion into the study. Both the groups underwent a pre-test assessment of Foot alignment, Plantar Pressure and ankle range of motion through foot print as photographs, Foot Pressure Index-6 and goniometer. Foot print of all the subjects who participated in the study was taken and the placement of the foot and degree of alignment were measured. Foot Posture Index-6 is a method of rating of foot posture and has 6 values: -2,-1,0,+1,+2 which measures the talar head palpation, supra and infra lateral malleoli curvature, calcaneal frontal plane position, prominence in the region of talonavicular joint, congruence of medial longitudinal arch and abduction/ adduction of forefoot from rear end. A total of all the individual scores are marked and summated. Ankle range of motion was measured in lying position.

After the pre-test scoring was done the subjects in the control group received Conventional Physiotherapy Exercises to correct the toe walking which included passive range of motion exercises for ankle, foot and knee, Passive stretching of TA in lying position and Frenkel's exercises drawn on floor. These exercises were performed for a period of 4 days a week for 8 weeks. The subjects in the Experimental group received the Sensorimotor exercises which included TA stretching in lying position, tandem walking, zig-zag walking, walking on pebbles and sand with instruction to place the entire foot, wedge standing, penguin walking and assisted sitting to standing position with pressure over the knee of the subject to maintain the full contact of the foot while getting up. The exercise duration for a session lasted for 45 minutes and was done 4 days a week for 8 weeks. A post-test measurement was done for all the outcome measures similar to that of the pre-test measurement.

STASTICAL ANALYSIS

The data was analyzed using SPSS 25 software version. The normal distribution and homogeneity were analyzed. The paired t-test was done for within group analysis and unpaired t-test was done for between group analysis. The significance level was fixed at 0.05 and a confidence interval of 95%. The foot prints were compared for foot placement visually.

RESULT

The results of the study showed that there was a significant difference in the unpaired t-test of the post-test values of ankle plantar flexion and FPI-6 with a mean difference of 1.28 and 2.73, significant at $p<0.05$ and in ankle dorsiflexion there was no significant improvement. It is presumed that the Experimental group performed well in Plantar pressure and ankle range of motion. The paired t-test showed significant improvement in the FPI-6 of experimental group alone with a mean difference of 0.21 significant at $p<0.05$. The ROM of dorsiflexion and Plantar flexion showed

improvement in both the control group and experimental group.

Within Group analysis

Variable	Group	Test	Mean	MD	t-test
FPI-6	Control	Pre	-1.9	0.4	1.247
		Post	-1.5		
	Exp	Pre	-2	0.8	2.675
		Post	1.2		
Ankle DF	Control	Pre	15.74	0.007	1.312
		Post	15.83		
	Exp	Pre	17.02	1.04	1.761*
		Post	10.06		
Ankle PF	Control	Pre	36.68	0.15	1.321
		Post	36.83		
	Exp	Pre	37.67	0.43	1.432*
		Post	38.10		

Between-group analysis

Variable	Group	Mean	MD	t-test
FPI-6	Control Pre	-1.9	-0.17	0.034
	Exp Pre	-2		
	Control Post	-23	-4.00	-2.437*
	Exp Post	18		
Ankle DF	Control Pre	15.74	1.28	-1.294
	Exp Pre	17.02		
	Control Post	15.83	2.22	-1.420*
	Exp Post	18.06		
Ankle PF	Control Pre	36.68	0.99	0.0831
	Exp Pre	37.67		
	Control Post	36.83	1.27	-1.887*
	Exp Post	38.10		

DISCUSSION

The aim of the study was to find the effect of the sensorimotor exercises in reducing toe-walking in autistic children between the age group of 2 & 5 years. Lyden et al (2014) identified Toe walking as second concern next to visual stimming and needed an early intervention to normalize the tone of the tendochilles and prevent further contractures of TA. This was augmented by a study conducted by Persicke et al., (2019) where a variety of exercises were incorporated to the autistic children to inhibit the toe-walking who found that these exercises played a vital role in reducing the tone of the Achilles muscle with a positive result on the contractile unit of the muscle helping in smooth contraction and relaxation of the contractile units.[10] This is in accordance with the current study which shows that the sensorimotor exercises left a visibly observable difference in the tone of the muscle and further improvement in the plantar flexion of the ankle.[11] The plantar pressure is a measure that shows the impact of the pressure of different parts if the foot. Bennett et al.,(1993) pointed that any alteration in plantar pressure[12] would bring about a remarkable change in walking pattern which is in line with the current study that showed a significant difference in foot pressure index-6 in the group that received sensorimotor exercises. It is perceived that the placement of fore foot on the ground during the initial stage of gait will produce a change of pressure under the metatarsal heads and the hallux.

CONCLUSION

It is concluded from the present study that the sensorimotor exercises brought a change in walking pattern of autism children with a history of toe-walking.

Declaration by Authors

Ethical Approval: Approved

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Conflict of Interest: The authors declare no conflict of interest.

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