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EFFECT OF MANUAL THERAPY (MET) VS CONVENTIONAL THERAPY FOR IMPROVING TENDO-ACHILLES (TA) FLEXIBILITY AND FOOT POSTURE IN CHILDREN WITH AUTISM SPECTRUM DISORDER

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ABSTRACT

Background: Autism Spectrum Disorder (ASD) is a disorder of neurodevelopment, which affects individuals across social, ethnic, and geographic groups. Autistic children have difficulty with gross motor and fine motor functioning difficulties, including a wide range of signs and symptoms. Toe walking due to TA tightness is commonly observed gait in autistic children altering foot posture in them. The knowledge about the abnormalities can be useful for the assessment and treatment planning of ASD children. We evaluated TA tightness, ROM of the ankle joint, and compare the effect of manual therapy (MET) and conventional therapy for improving TA flexibility and foot posture.

Methods: An RCT included 20 diagnosed autistic children(13male,7female) as per inclusion criteria the subjects were divided into two groups, i.e., group A and B, the group A was given Conventional Therapy in the form of passive stretching whereas Group B was given Manual Therapy in the form Muscle Energy Technique. The participants were clinically examined and evaluate TA tightness in the form of Elastography, Range of motion, and foot posture. Data were taken as pre and after post-intervention.

Results: There were significant changes in elastography readings, foot posture index, and range of motion in both groups post-intervention, but significant improvement was observed in group B as compared to group A, i.e., $p>0.05$.

Conclusion: This has been concluded that there is a significant effect of Manual therapy in the form of muscle energy technique for improving TA flexibility and foot posture as compared to conventional treatment.

Keywords: Autism Spectrum Disorder, ASD, conventional therapy, elastography, manual therapy, a neurodevelopmental disorder.

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INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that affects individuals across social, ethnic, and geographic groups [1]. It affects more than 3 million people in the Indian subcontinent. According to the ASD guidelines of WHO, 'The Center for Disease Control and Prevention' (CDC) found that ASD occurred even 1 out of 59 in 2018 (which is supposed to be increasingly accurate) indicating that young individuals have ASD in India owing to the stress due to the multifaceted clinical nature of the situation with increased prevalence (1 out of every 65 children 2-9 years old) [2].

The Autism Spectrum issue since it includes a wide range of signs and symptoms that incorporate formative disorders, conduct issues such as hyperactive, hostility, discourse and language, poor eye-to-eye contact, and redundant play [1]. These Children also faces issues of social collaboration, as well as language abilities with numerous children showing prohibitive dull behavior [4]. Motor stereotypes are defined as involuntary, facilitated, designed, dreary, cadenced, and purposeless, yet deliberate developments [4,5]. They also show an abnormal pattern of gait.

A situation in which children not walk a typical heel-toe gait but walk on their toes is called heel-toe walking [7]. It can lead to the contracture of tendo-achillies or muscle tightness that eventually changes foot posture [5]. Toe-walking is defined as a variation in motor development, frequently found in children with ASD.[6] Persistent toe walking can lead to gait deviations in ASD children as Kanner et al. (1943) as a 'clumsy gait' in children with ASD leading to defects in foot posture [5]. ASD children are more susceptible to idiopathic walking, leading to tendo-achillies tightness [7].

The neuroimaging studies of ASD show abnormalities in parts of the brain, including the frontal cortex, cerebellum, the amygdaloid nucleus, hippocampus [8] and cerebello-thalamo-cortical pathways which show reduced ipsilateral cerebellum activation during gross motion and more diffuse activation in lobules VI-VII [9]. Postural control and gait deficits were connected to dysfunction in sensory integration with the basal ganglia or cerebellum due to similarities with gait abnormalities [3,10]. Hallett et al. (2015) conducted the first survey of kinematic and kinetic patterns of gait in adults with ASD and found that during gait to demonstrate "mild clumsiness," significant abnormalities at the ankle joint showing decreased range of motion [6,10].

As noted above, tightness of the TA can lead to the deleterious effect of lower limb function and, therefore, to the abnormal arches of the foot resulting in dropping incidence. TA tightness and abnormal alignment of foot bone structures result in a more predominant force of deformation, resulting in pathological changes in the foot and ankle [11]. Different methods of the technique have been conducted to see the impact of moist heat, elastography, conventional therapy, and manual therapy (MET) to improve the flexibility of different muscles and also helps to improve the Range of motion.

MATERIALS AND METHODS

An RCT was conducted in the Department of Community Health Physiotherapy, Ravi Nair Physiotherapy College, Sawangi (Meghe), Wardha. Ethical approval was obtained from the institutional ethical committee of the University with (Ref. No. (IEC) DMIMS (DU)/IEC/JUNE2019/8015). Treatment was given to each of the subjects for three days a week and six weeks. Inclusion criteria were all gender with the age group of 4-10 years, subjects diagnosed cases of autism spectrum disease with TA tightness, and their exclusion criteria were Suspected but undiagnosed cases of ASD, Presence of any limb deformities (polio, congenital talipes equino Varus, spastic cerebral palsy), Operated cases of tendon release, Autistic children with MR, Unwillingness of participant or parents to be a part of the study. The materials used for the study included Universal Half Goniometer, Elastography, Foot Posture Index, written consent forms, and assessment forms.

Methodology

We have done purposive sampling with 23 subjects who were recruited from the Department of Pediatric of Acharya Vinoba Bhave Rural Hospital (AVBRH) Sawangi, Meghe Wardha. A written consent form was taken from the children's parents or guardians. The duration of the study was conducted from Oct 27, 2017, to Oct 30, 2019, with a study duration of 12 months.

Out of 23 children, three were excluded from the study because one of the subjects was found under the exclusion criteria, while two were not regular for the follow-ups. Thus the total number of final subjects 20 were allotted into two groups by a simple lottery method as per inclusion criteria.

The pre-assessment was done for both groups in the form of a range of motion, elastography, and foot posture index to quantify TA tightness. After that, subjects were subdivided into two groups, i.e., Experimental and control from which Group A, ten children, i.e. (five male, five female) were provided standard treatment in the form of passive stretching against resistance for 5-10 seconds hold and release, repeat it for 1-3 times as per subject tolerance. Group B, ten children, i.e. (eight male, two female) were provided standard treatment in the form of manual therapy (muscle energy technique), a submaximal (10-20%) contraction of a muscle is performed for 5-10 seconds, the procedure is repeated 2-3 times, Moist heat remain same in both groups. The Range of Motion, Elastography, and Foot Posture Index readings were taken after the intervention. The treatment was given to each of the children for thrice a week, for four weeks.

Elastography is a medical ultrasonographic imaging technique used to map information about the stiffness of soft tissues or pathology related to soft tissue. In this study, shear wave elastography was used to quantify TA tightness [12]. Imaging of the lateral gastrocnemius, soleus, and subcutaneous tissue was conducted with the subject in

a prone lying position, with the ankle positioned at the edge of the table in a neutral position. Examiner applied sufficient aquasonic gel on the posterior aspect of the calf to get an appropriate image; the examiner was responsible for re-identifying the region of concern. Foot posture index (FPI) is a 6 item scale used for evaluating foot posture to find out how pronated, neutral, or supinated a foot is [13]. The patient stood in their upright stance position with double limb support, with their arms by their side and looking straight. During the evaluation, it is essential to take note of sway in the patient because this will notably affect foot posture.

DATA ANALYSIS

Statistical analysis was done using descriptive and inferential statistics using student's paired and unpaired t-test. The software used in the analysis was SPSS 22.0 version with $p<0.05$ was considered as the level of significance.

Table 1: Distribution of patients according to their age in years

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Group A	10	4	10	7.50	2.06
Group B	10	5	10	7.40	1.57

The mean age of the patients of group A was 7.50±2.06, and group B was 7.40±1.57 years.

Table 2: Distribution of patients according to their gender

Gender	Group A	Group B
Male	5(50%)	8(80%)
Female	5(50%)	2(20%)
Total	10(100%)	10(100%)

Each 50% in-group A belonged to the same gender, and 80% and 20% in-group B were females, respectively.

Table 3: Distribution of patients according to elastography tightness

Elastography Tightness	Group A		Group B	
	Pre Test	Post Test	Pre Test	Post Test
Soft	0(0%)	6(60%)	0(0%)	7(70%)
Hard	5(50%)	0(0%)	5(50%)	0(0%)
Intermediate	5(50%)	4(40%)	5(50%)	3(30%)
Total	10(100%)	10(100%)	10(100%)	10(100%)
χ2-value	11.11,p=0.0039,S		12.50,p=0.0019,S	

Elastrography tightness was hard and intermediate in 50% of the patients of group A at pre-test and was soft in 60% of the patients of Group A at post-test and was intermediate in 40% of the cases in group A. Difference was statistically significant(χ2-value=11.11,p=0.0039).

Elastrography tightness was hard and intermediate in 50% of the patients of group B at pre-test and was soft in 70% of the patients of Group B at the post-test and was intermediate in 30% of the cases in group A. Difference was statistically significant(χ2-value=12.50,p=0.0019).

Table 4: Comparison of dorsiflexion range of motion in group A pre and post-test Student's unpaired t-test

Group	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Pre Test	10	7.50	1.58	0.50	4.10±0.73	17.57 P=0.0001,S
Post Test	10	11.60	1.42	0.45		

Mean dorsiflexion range of motion in patients of group A at pre-test was 7.50±1.58, and at post-test, it was 11.60±1.42. By using Student's paired t-test statistically significant difference was found in the dorsiflexion range of motion in at pre and post-test (t=17.57, p=0.0001).

Table 5: Comparison of dorsiflexion range of motion in-group B pre and post-test

Student's unpaired t-test

Group	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Pre Test	10	7.90	2.07	0.65	4.50±0.70	20.12 P=0.0001,S
Post Test	10	12.40	2.17	0.68		

Mean dorsiflexion range of motion in patients of group B at pre-test was 7.90±2.07, and at post-test, it was 12.40±2.17. By using Student's paired t-test statistically significant difference was found in the dorsiflexion range of motion in at pre and post-test (t=20.12,p=0.0001).

Table 6: Comparison of dorsiflexion range of motion in two groups

Student's unpaired t-test

Group	N	Mean	Std. Deviation	Std. Error Mean	t-value
Group A	10	11.60	1.42	0.45	0.97 P=0.34,NS
Group B	10	12.40	2.17	0.68	

Mean dorsiflexion range of motion score of group A was 11.60 ± 1.42, and in that of group B, it was 12.40 ± 2.17. By using Student's unpaired t-test statistically, no significant difference was found in the dorsiflexion range of motion score in patients of two groups (t=0.97,p=0.34).

Table 7: Comparison of foot posture index score in group A pre and post-test

Student's unpaired t-test

Group	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Pre Test	10	-2.80	7.28	2.30	-3.30±4.90	2.13 P=0.062,NS
Post Test	10	0.50	4.55	1.43		

The mean foot posture index score in patients of group A at the pre-test was -2.80±7.28, and at the post-test, it was 0.50±4.55. By using Student's paired t-test statistically, no significant difference was found in the foot posture index score in at pre and post-test (t=2.13,p=0.062).

Table 8: Comparison of foot posture index score in group B pre and post-test

Student's unpaired t-test

Group	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Pre Test	10	-1.60	6.09	1.92	-6.10±5.62	3.42 P=0.002,S
Post Test	10	4.50	0.97	0.30		

The mean foot posture index score in patients of group B at the pre-test was -1.60±6.09, and at post-test, it was 4.50±0.97. By using Student's paired t-test statistically significant difference was found in the foot posture index score in at pre and post-test (t=3.42,p=0.002).

Table 9: Comparison of foot posture index score in two groups

Student's unpaired t-test

Group	N	Mean	Std. Deviation	Std. Error Mean	t-value
Group A	10	0.50	4.55	1.43	2.71 P=0.014,S
Group B	10	4.50	0.97	0.30	

The mean foot posture index score of group A was 0.50 ± 4.55, and in that of group B, it was 4.50 ± 0.97. By using Student's unpaired t-test statistically significant difference was found in the foot posture index score in patients of two groups(t=2.71,p=0.014).

DISCUSSION

The impetus of the current study was to analyze the result of manual therapy using muscle energy technique (MET) and conventional physiotherapy for improving the flexibility of tendo-achillis and the foot posture in children with ASD.

We used elastography for testing TA tightness, which is the vital assessment tool to check the TA flexibility, which shows the significant improvement in group b, i.e., p = 0.001. Shear wave elastography was recently used to see the interrelation of muscle elasticity and passive joint stiffness.

Chakouch MK et al. (2016) [12] used Magnetic Resonance Elastography and quantified the elastic property of muscle. The various elasticities evaluated between the tissues which may show different contrast in the muscles' compositions and physiological. Thus, the current protocol may be applied to wounded muscles to see their behavior of an elastic property. The old studies on muscle pathology set up that quantification of the shear modulus must be used as a clinical protocol to point out muscle pathology, to get follow-up effects of treatments [14].

The current study found that the new pre and post comparison of dorsiflexion range of motion in both conventional therapy and manual therapy treatment groups was significantly increased in both groups. Still, the mean difference was less increased in the two groups. Muscle energy technique markedly increased in dorsiflexion range on treatment day or between treatment days, which indicates that both treatment techniques were equally effective in improving the dorsiflexion range of motion.

Akins RS et al. (2015) [15] suggested that the superficial heating modalities help to improve ROM and are more related to sensory feedback that help change in length of a muscle. Heat acts as an analgesic and may help to alleviate some of the pain associated with stretching, thus allowing for a more significant and beneficial stretch. Thus the thermoregulatory responses of our body help in improving blood flow through the branches of the sympathetic nervous system. These dual sympathetic mechanisms of neural control produce thermoregulatory responses to our body. It helps to relax the tight muscle and to improve the blood circulation of the tight region and to retain relaxation for improving the length of the muscle [16]. So in the present study, superficial heating modality used impacted the length of Gastrocnemius muscle, thus increasing TA flexibility by improving ankle dorsiflexion ROM.

The foot posture index is a known reliable and valid clinical instrument with excellent accuracy, quantifies the level and degree of the foot, which is pronated, supinated, or neutral in standing position. A greater favorable value indicated a more pronated foot and a lower value demonstrated supinated foot [17].

The outcome suggests that the pre-post comparison of the FPI score in both groups was markedly increased in both conventional therapy and manual therapy group. Still, it was considerably showed more improvement in the manual therapy group after comparing mean difference in FPI score between both groups suggested that the difference between the two groups was statically significant and gives impact to physiotherapy treatment. So the mean change in FPI in manual therapy was higher as compared to conventional therapy, i.e. (p =0.001).

Alfonso Martínez-Novaa et al. (2018) [18] suggested that in the physical examination of foot posture, clinicians are more closely observe the supinated or highly supinated foot than the asymptomatic pronated foot, which is most likely normal. The supinated foot can also consider less problem because it is more prone to foot injuries in children [19].

Therefore, the analysis of both the group shows there is a significant improvement in both groups, i.e., group A conventional therapy and group B Manual Therapy but more in group B, i.e., Manual Therapy and along with Range of motion, the foot posture index also shows better improvement in group B, i.e., manual therapy (MET) on the children with ASD.

CONCLUSION

Based on observation and the results, we concluded that there is a significant effect of Manual therapy in the form of muscle energy technique for improving TA flexibility and foot posture as compared to conventional therapy.

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Conflict of Interest: Nil

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REFERENCES

[1] Juneja M, Sairam S. Autism Spectrum Disorder - An Indian Perspective. 2018.

[2] Daley TC. From symptom recognition to diagnosis: children with autism in urban India. Social Science & Medicine. 2004 Apr;58(7):1323–35.

[3] Oakley C, Mahone EM, Morris-Berry C, Kline T, Singer HS. Primary Complex Motor Stereotypies in Older Children and Adolescents: Clinical Features and Longitudinal Follow-Up. Pediatric Neurology. 2015 Apr;52(4):398-403.e1.

[4] Williams CM, Pacey V, de Bakker PB, Caserta AJ, Gray K, Engelbert RH. Interventions for idiopathic toe walking. Cochrane Neuromuscular Group, editor. Cochrane Database of Systematic Reviews [Internet]. 2016 Oct 3 [cited 2019 Jul 15]; Available from: http://doi.wiley.com/10.1002/14651858.CD012363

[5] Blacher J, Christensen L. Sowing the Seeds of the Autism Field: Leo Kanner (1943). Intellectual and Developmental Disabilities. 2011 Jun;49(3):172–91.

[6] Engström P, Tedroff K. Idiopathic Toe-Walking: Prevalence and Natural History from Birth to Ten Years of Age. The Journal of Bone and Joint Surgery. 2018 Apr;100 (8):640–7.

[7] Esposito G, Venuti P. Analysis of Toddlers' Gait after Six Months of Independent Walking to Identify Autism: A Preliminary Study. Percept Mot Skills. 2008 Feb;106(1):259–69.

[8] Kaur M, M. Srinivasan S, N. Bhat A. Comparing motor performance, praxis, coordination, and interpersonal synchrony between children with and without Autism Spectrum Disorder (ASD). Research in Developmental Disabilities. 2018 Jan;72:79–95.

[9] Kaur M, M. Srinivasan S, N. Bhat A. Comparing motor performance, praxis, coordination, and interpersonal synchrony between children with and without Autism Spectrum Disorder (ASD). Research in Developmental Disabilities. 2018 Jan;72:79–95.

[10] Kindregan D, Gallagher L, Gormley J. Gait Deviations in Children with Autism Spectrum Disorders: A Review. Autism Research and Treatment. 2015;2015:1–8.

[11] Bishop C. Evaluation of Pediatric Toe Walking. Physician Assistant Clinics. 2016 Oct;1(4):599–613.

[12] Chino K, Takahashi H. Measurement of gastrocnemius muscle elasticity by shear wave elastography: association with passive ankle joint stiffness and sex differences. Eur J Appl Physiol. 2016 Apr;116(4):823–30.

[13] Gijon-Nogueron G, Montes-Alguacil J, Alfageme-Garcia P, Cervera-Marin JA, Morales-Asencio JM, Martinez-Nova A. Establishing normative foot posture index values for the paediatric population: a cross-sectional study. J Foot Ankle Res. 2016 Dec;9(1):24.

[14] Tan K, Jugé L, Hatt A, Cheng S, Bilston LE. Measurement of large strain properties in calf muscles in vivo using magnetic resonance elastography and spatial modulation of magnetization. NMR in Biomedicine. 2018 Oct;31(10):e3925.

[15] Manning C, Tibber MS, Charman T, Dakin SC, Pellicano E. Enhanced Integration of Motion Information in Children With Autism. Journal of Neuroscience. 2015 May 6;35(18):6979–86.

[16] Eggleston JD, Harry JR, Dufek JS. Lower extremity joint stiffness during walking distinguishes children with and without autism. Human Movement Science. 2018 Dec;62:25–33.

[17] McCahill J, Stebbins J, Koning B, Harlaar J, Theologis T. Repeatability of the Oxford Foot Model in children with foot deformity. Gait & Posture. 2018 Mar;61:86–9.

[18] Martínez-Nova A, Gijón-Noguerón G, Alfageme-García P, Montes-Alguacil J, Evans AM. Foot posture development in children aged 5 to11 years: A three-year prospective study. Gait & Posture. 2018 May;62:280–4.

[19] Ilias S, Tahir NM, Jailani R, Hasan CZC. Linear Discriminant Analysis in Classifying Walking Gait of Autistic Children. In: 2017 European Modelling Symposium (EMS) [Internet]. Manchester: IEEE; 2017 [cited 2020 Mar 14]. p. 67–72. Available from: https://ieeexplore.ieee.org/document/8356792/

LIST OF ABBREVIATIONS

ABBREVIATIONS	PARTICULARS
ASD	Autism Spectrum Disorder
TA	Tendo-Achillies
MET	Muscle energy technique
UES	Ultrasound Elastograpy
MR	Mental Retardation
FPI	Foot Posture Index
EUS	Elastography Ultrasound