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EFFECTIVENESS OF MYOFASCIAL RELEASE OF PLANTAR FLEXORS ON PLANTAR FLEXOR SPASTICITY AND GAIT VELOCITY IN SUBJECTS WITH SPASTIC CEREBRAL PALSY

Physiotherapy

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ABSTRACT

Cerebral palsy (CP) is a group of motor impairments due to brain abnormalities in early development, often leading to spasticity and functional limitations, particularly affecting daily living activities like gait and feeding. This study aimed to evaluate the effectiveness of Myofascial Release (MFR) on plantar flexor spasticity and gait velocity in children with spastic CP. Thirty participants, aged 8–14 years, were divided into an Experimental group (receiving MFR and conventional treatment) and a Control group (receiving conventional treatment only). Both groups received treatment for 6 weeks, with outcomes measured using the Modified Tardieu Scale and Timed 10-Meter Walk Test. Results showed significant improvements in the Experimental group, particularly in plantar flexor spasticity and gait velocity, compared to the Control group (p = 0.0001). The study concludes that combining MFR with conventional treatment effectively improves spasticity and gait in children with spastic cerebral palsy.

KEYWORDS

Cerebral palsy, Myofascial release, Modified Tardieu Scale, Gait velocity, Daily living activities (ADL).

INTRODUCTION

Cerebral palsy (CP) is a group of non-progressive motor impairment syndromes caused by brain lesions or abnormalities during early development, leading to secondary musculoskeletal issues like muscle weakness, joint tightness, contractures, and gait abnormalities [1]. Children with CP often face muscle impairments such as spasticity and decreased motor control, which affect activities like walking, endurance, speed, and stair climbing [2]. Additionally, CP is frequently accompanied by sensory, cognitive, communication, perceptual, and behavioral disturbances, and may involve seizure disorders [3]. The neurological injury in CP causes muscular changes, including fibrosis, shortening, atrophy, and overstretched sarcomeres, which results in fewer in-series sarcomeres due to a combination of longer sarcomeres and shorter muscle fibers [4].

Prevalence and Incidence of Cerebral Palsy (CP): Cerebral palsy (CP) prevalence ranges globally from 1.5 to 3 per 1,000 live births, with higher rates in low- and middle-income countries (LMICs) at 3.4 per 1,000. In India, the prevalence is 2-3 per 1,000, with spastic CP being the most common form. The global incidence of CP is 1-4 per 1,000 newborns, with similar rates in India, particularly in premature infants. CP remains the leading motor disability in children worldwide [5,6,7,8,9].

The role of plantar flexors (APF) in the gait cycle is complex, with debate on their functions during walking. APFs primarily contribute to "push-off," performing significant concentric work at the end of single-limb and through double-limb support. This work increases the leg's kinetic and potential energy, aiding leg acceleration into the swing phase. While APFs contribute to trunk energy, their role in lifting the trunk is minimal. Energy transfer between the leg and trunk continues in the swing phase, with the hip flexors contributing to forward leg acceleration [10,11].

Spasticity, the most common motor impairment in 60% of children with cerebral palsy (CP), arises from damage to the corticospinal tract, causing fatigue, coordination issues, contractures, and joint subluxations [12]. CP patients often experience muscle weakness, particularly in the plantar flexors, which generate less torque during isometric contractions compared to walking [13]. Gait deviations in CP are diverse and can overlap, making classification challenging, with Clinical Gait Analysis (CGA) crucial for evaluation. In unilateral spastic CP, gait patterns range from foot drop to restricted hip and knee movement, while bilateral spastic CP includes equinus, jump gait, and crouch gait, involving abnormal limb movements [14]. Tight plantar flexors disrupt walking mechanics and reduce gait efficiency [15].

NEED OF THE STUDY

A survey on adult cerebral palsy (CP) indicated that 77% of children with CP experience spasticity, 80% have contractures, and 18% suffer from daily pain.

Recent studies have examined the short-term effects of Myofascial Release (MFR) on calf muscle spasticity in spastic CP patients, showing significant improvement in plantar flexor spasticity after 4 weeks of treatment with MFR and stretching ($p<0.05$).

Another study compared the effectiveness of MFR versus passive stretching in reducing spasticity, finding passive stretching to be more effective for alleviating plantar flexor spasticity.

These studies suggest that both MFR and stretching are primarily beneficial in relieving plantar flexor muscle spasticity.

However, there is limited research on the combined impact of MFR and stretching on both spasticity and gait velocity.

Therefore, the current study aims to investigate the combined effects of MFR and passive stretching on plantar flexor spasticity and gait velocity using the Modified Tardieu Scale (MTS) and Timed 10-meter Walk Test (T10MWT).

AIM

The study aims at evaluating the effectiveness of the Myofascial release of Plantar flexors on Plantar flexor Spasticity and Gait velocity in subjects with Spastic Cerebral palsy.

OBJECTIVES

- To know the effectiveness of Myofascial release of Plantar flexors on Plantar flexor spasticity by The Modified Tardieu Scale (MTS) in Experimental group subjects with Spastic hemiplegic cerebral palsy.
- To know the effectiveness of Myofascial release of Plantar flexors on Gait velocity by Timed 10-meter walk test (T10MWT) in Experimental group subjects with Spastic hemiplegic cerebral palsy.
- To know the effectiveness of Passive Stretching of Plantar flexors on Plantar flexor spasticity by The Modified Tardieu Scale (MTS) in Control group subjects with Spastic hemiplegic cerebral palsy.
- To know the effectiveness of Passive Stretching of Plantar flexors on Gait velocity by Timed 10-meter walk test (T10MWT) in Control group subjects with spastic hemiplegic cerebral palsy.
- To Compare the effectiveness of Myofascial release and Conventional treatment in Experimental group and Conventional treatment in Control group by The Modified Tardieu Scale and Timed 10-meter walk test in subjects with Spastic Hemiplegic Cerebral palsy.

MATERIALS AND METHODOLOGY

MATERIALS

Materials For Evaluation:

1. Stopwatch.
2. Measuring tape.
3. Cones.
4. Universal Goniometer.

Materials For Intervention

1. Ice pack
2. Manipulation couch.
3. Drape sheet.
4. Pillows.
5. Stepper.

METHODOLOGY

Study Design: Randomized control trial.

Sampling Technique: Purposive sampling method.

Randomization method: Simple random sampling by lottery method

Sample Size: 30 Subjects. {Group-A = 15 subjects, Group-B = 15 subjects}.

Study Setting:
1. College of Physiotherapy, SVIMS, Tirupati.
2. Sri Venkateswara Ayurvedic Hospital, Tirupati.
3. Sri Venkateswara Ram Narayan Government General Hospital, Tirupati (SVRRGGH).

Study duration: 7 months.

Treatment Duration: 6 weeks.

Ethical code: **IEC No.1749, Date: 11.9.2024.**

Inclusion Criteria:

1. Children of age group 8 to 14 years.
2. Both the genders.
3. Modified Ashworth Scale: Grade 3 and <3.
4. Children with Spastic Hemiplegic Cerebral Palsy.
5. Children with Wechsler Intelligence Scale-V (WISC-V) score = High Average: 110-119/159.
6. Gross Motor Function Classification System - Expanded and Revised (GMFCS-ER) = Level-1 and 2.
7. Gross Motor Function Measure (GMFM) = 60-66 (walking, running, and jumping balance).

Exclusion Criteria:

1. Botulinum toxin injection in the past 6 months.
2. Mental retardation.
3. Serial casting in the past 6 months.
4. Taking Intrathecal myorelaxant drugs.
5. Recent fractures.
6. Prior Orthopaedic surgeries.
7. Any Inflammatory conditions. (like Rheumatoid arthritis)
8. Having any active infections and open wounds.
9. Subjects with visual and auditory deficits.
10. Subjects with cognitive dysfunction.
11. Subjects with other types of cerebral palsy.

Outcome Measures:

1. The Modified Tardieu Scale (MTS).
2. Timed 10 Meter Walk Test (T10MWT).

Study Procedure:

The study was performed after getting approval from **IEC No.1749.** All subjects meeting the inclusion criteria were included in the study after both parents and subjects received a thorough explanation of the procedure. Written consent was then obtained from the parents. The subjects were then divided into two groups, Group A and Group B, using a lottery method.

Group = A (Experimental group), 15 subjects.

Group = B (Controlled group), 15 subjects.

Experimental Group Treatment Protocol:

Myofascial Release (MFR) Technique (GROUP-A):

Positioning: Subject is positioned in prone or supine lying based on the targeted muscle group. For plantar flexors, prone positioning is common to ensure accessibility to the calf muscles.

Procedure:

- For the calf muscle, the Myofascial Release (MFR) technique was administered with subjects in a prone position, utilizing a 120-second hold.
- To apply the MFR, finger pads were allowed to sink into the central portion of the calf. The position was held for 120 seconds to permit tissue softening, after which the myofascial structures were gently spread in a lateral direction until encountering the first fascial barrier.
- The position was then maintained until the release of the barrier, and the procedure was continued to follow the tissue through each subsequent barrier.
- The Myofascial Release (MFR) technique was applied for 15-20 minutes [16].

Figure.1 Myofascial Release Techniques Applied To Subjects.

Conventional Treatment:

Passive Stretching:

- Passive stretching was given to the Gastrocnemius and soleus muscles.
- **Procedure:** Passive stretching exercises were carried out by a therapist without the subject's muscular involvement. The muscle to be stretched was lengthened as the therapist manually moved the joint of the patient to its end-range position. The therapist held this end-range position for 60-80 seconds.

Gastrocnemius Muscle:

- **Position of the subject:** Supine lying.
- **Instructions:** Position the child lying on the back with the hand stabilizing the knee. Place the other hand around the child's heel with the palm along the length of the foot and gently push the foot upwards with the knees straight. Ensure that the ankle does not roll in or out.

Soleus Muscle:

- **Position of the subject:** Supine lying.
- **Instructions:** Position the child lying down on the back. Place the hand around the child's heel with the palm along the length of the foot and gently push the foot upwards with the knees bent. Ensure that the ankle does not roll in or out.

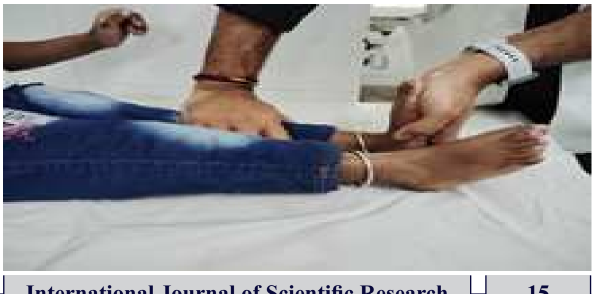


Figure.2 Passive stretchings (Gastrocnemius and Soleus) applied to subjects.

CRYOTHERAPY APPLICATION:
Cryotherapy was administered after each repetition of passive stretching, lasting 2-3 minutes.

Weight-bearing Exercises:
Weight-bearing exercises consisted of 3 repetitions, with a 15-20 second hold time, performed 6 sessions per week, for 6 weeks [17].

CONTROL GROUP TREATMENT PROTOCOL:
Conventional Treatment (GROUP-B):
Passive Stretching:
Passive stretching exercises were carried out by a therapist without the subject's own muscular involvement. The muscle to be stretched was lengthened as the therapist manually moved the joint of the subject to its end-range position. The therapist held this end-range position for 60-80 seconds.

Cryotherapy Application:
Cryotherapy was administered after each repetition of passive stretching, lasting 2-3 minutes.

Weight-bearing Exercises:
Weight-bearing exercises consisted of 3 repetitions, with a 15-20 second hold time, performed 6 sessions per week, for 6 weeks [17].

Advised Passive Stretching At Home:
Passive stretchings were taught to the subject's parents.

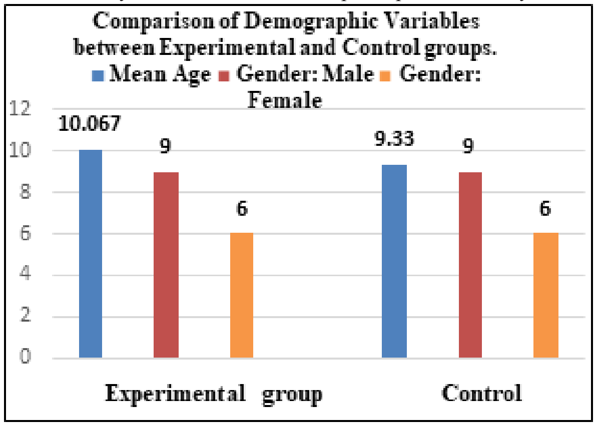
Statistical Analysis:
- The statistical analysis was performed using the "SPSS 20.0 version software. The data was first entered into a Microsoft Excel spreadsheet, tabulated, and then subjected to statistical analysis.
- All the descriptive statistical data were presented in the form of mean and standard deviation was calculated and graphically represented.
- All 30 participants completed the study protocol within six weeks of treatment sessions.
- To determine the effectiveness of the treatment, a t-test was used for pre-and post-values of T10MWT in the Control group as the distribution of data was normal, as the Mann Whitney U test for pre and post-values of MTS in the control and Experimental group and T10MWT in Experimental group as the data is not normally distributed.
- For all statistical analyses, $p < 0.05$ is considered as significant.

RESULTS

Table - 1 Comparison Of Demographic Variables Between Experimental And Control Groups.

Variables	Subjects with MFR and Conventional Treatment Group (N=15)	Subjects with Conventional Treatment Group (N=15)
Mean Age: Years	10.067 ± 1.9445	9.33 ± 1.633
Gender: Male: Female	9:6	9:6

Baseline evaluation was done for the subjects in Groups A and B by using the Modified Tardieu Scale and Timed-10-Meter Walk Test. Subjects have undergone the intervention for 6 weeks and post-test evaluation was done by using the above measures and documented the findings. 30 subjects who met the inclusion criteria were explained about the study and consent was taken to participate in the study.



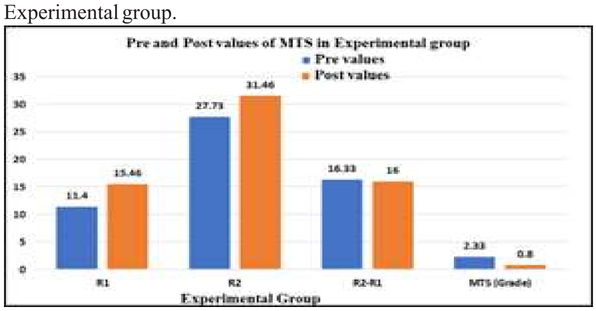
Graph – 1 Graphical representation of Age and Gender distribution in Experimental and Control groups.

Interpretation: The study involved participants with a mean age of 10.067 years (± 1.9445) in the Experimental group and 9.33 years (± 1.633) in the Control group. The gender distribution was balanced in both groups, with each consisting of 9 males and 6 females.

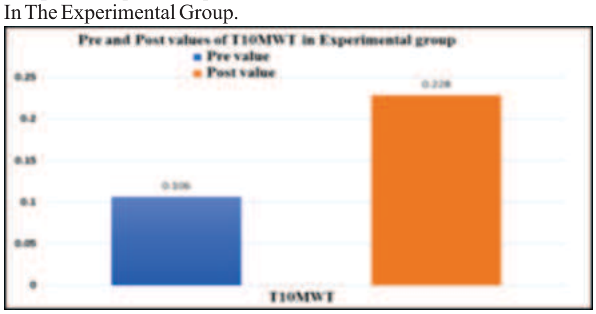
Table- 2 Experimental Group: Comparison Of Pre And Post Values Of MTS And T10MWT Within Groups.

Group	Mean	Mean difference	Standard deviation	T-value	P-value
R1 Pre	11.4	4.066	± 2.2745	19.72	< 0.0001
R1 Post	15.46		± 2.5785		
R2 Pre	27.73	3.733	± 2.2350	18.10	< 0.0001
R2 Post	31.46		± 2.2764		
R2- R1 Pre	16.33	-0.333	± 3.1763	1.099	< 0.0001
R2-R1 Post	16		± 3.7947		
MTS Pre	2.33	1.533	± 0.6992	11.50	< 0.0001
MTS Post	0.8		± 0.6532		
T10MWT Pre	0.106	0.122	± 0.008	24.42	< 0.0001
T10MWT Post	0.228		± 0.0245		

Interpretation: The paired t-test showed significant improvements in joint angle (MTS R1), range of motion/flexibility (MTS R2), spasticity (MTS Grade), and gait velocity (T10MWT) after the intervention. Joint angle increased from 11.4 to 15.46, range of motion from 27.73 to 31.46, spasticity decreased from 2.33 to 0.8, and gait velocity rose from 0.106 to 0.228. All changes were statistically significant ($p < 0.0001$), demonstrating reliable improvements within the Experimental group.



Graph- 2 Graphical Representation Of Pre- And Post-values Of MTS In The Experimental Group.



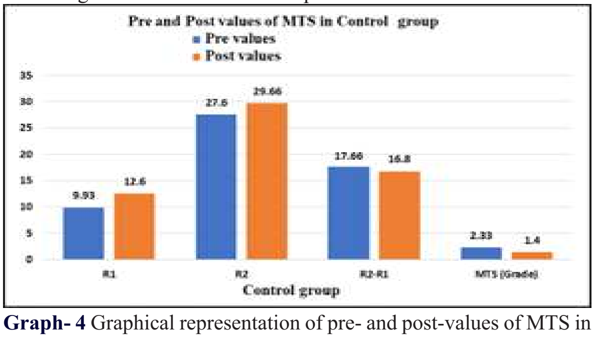
Graph- 3 Graphical Representation Of Pre- And Post-values Of

T10MWT within the Experimental group.

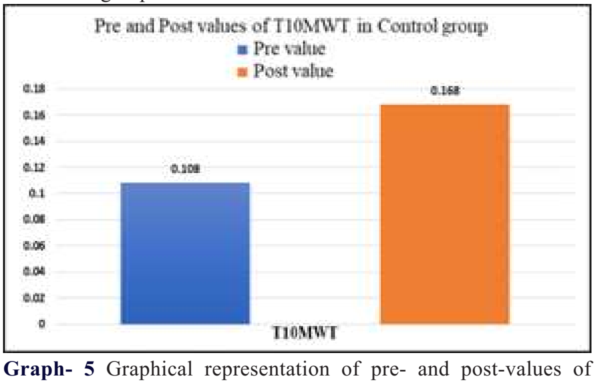
Table- 3 Control Group: Comparison Of Pre And Post-values Of MTS And T10MWT Within Groups.

Group	Mean	Mean differenc	Standard deviation	T-value	P-value
R1 Pre	9.933	2.667	± 0.8537	7.391	< 0.0001
R1Post	12.6		± 1.1431		
R2 Pre	27.6	2.066	± 2.0264	17.49	< 0.0001
R2 Post	29.666		± 2.1807		
R2-R1 Pre	17.666	-0.866	± 1.9888	1.781	< 0.0001
R2-R1Post	16.8		± 3.0811		
MTS Pre	2.333	0.933	± 0.6992	14.00	< 0.0001
MTS Post	1.4		± 0.6110		
T10MWT Pre	0.108	0.06	± 0.0083	30.74	< 0.0001
T10MWT Post	0.168		± 0.0122		

Interpretation: The paired t-test showed significant improvements within the Control group after the intervention in joint angle (MTS R1), range of motion/flexibility (MTS R2), and spasticity (MTS Grade and R2-R1). Joint angle increased from 9.933 to 12.6, range of motion from 27.6 to 29.666, spasticity (R2-R1) decreased from 17.666 to 16.8, and MTS Grade decreased from 2.333 to 1.4, all with p < 0.0001, indicating consistent and reliable improvements.



Graph- 4 Graphical representation of pre- and post-values of MTS in the Control group.

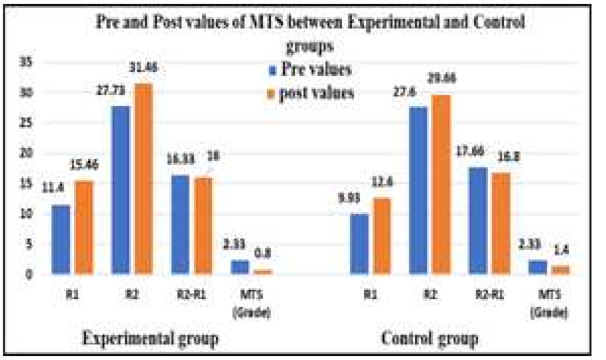


Graph- 5 Graphical representation of pre- and post-values of T10MWT in the Control group.

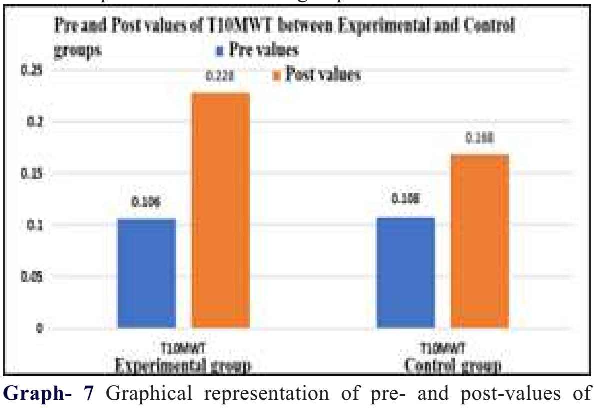
Table- 12 Comparison Of MTS & T10MWT Between Experimental And Control Groups.

Group		Mean Rank / Difference	Mann-Whitney-U-test	Unpaired-T-test (T-value)	P-value
R1	Experimental	15.466	-	3.803	0.0007
	Control	12.6			
R2	Experimental	31.466	-	2.136	0.0415
	Control	29.666			
MTS	Experimental	0.8	61.50	-	0.0310
	Control	1.4			
T10MWT	Experimental	0.228	0	-	< 0.001
	Control	0.168			

Interpretation: The experimental group showed significantly greater post-intervention improvements in joint angle (R1), range of motion (R2), spasticity (MTS grade), and gait velocity (T10MWT) compared to the control group. Statistically significant differences were found for R1 (t = 3.803), R2 (t = 2.136), MTS (U = 61.50), and T10MWT (U = 0), with p-values of R1 (p = 0.0007), R2 (p = 0.0415), MTS (p = 0.0310), and T10MWT (p < 0.0001), indicating reliable improvements.



Graph- 6 Graphical representation of pre- and post-values of MTS between Experimental and Control groups.



Graph- 7 Graphical representation of pre- and post-values of T10MWT between Experimental and Control groups.

DISCUSSION

This study assessed the effect of Myofascial Release on plantar flexor spasticity and gait velocity in children with spastic cerebral palsy. Thirty participants (8-14 years) were randomly divided into experimental and control groups. Significant improvements in MTS and T10MWT were noted, with the experimental group showing greater progress.

A study by Priya J. Tikhile et al. (2021) demonstrated that combining Myofascial Release (MFR) and Cryotherapy effectively reduced calf muscle spasticity in spastic diplegic cerebral palsy. Significant improvements in the Modified Ashworth Scale and dorsiflexion range of motion were observed in post-treatment [18].

In the Current study, the experimental group showed significant improvements in the Modified Tardieu Scale (MTS) after treatment, with R1 increasing from 11.4 to 15.46, R2 from 27.73 to 31.46, and MTS grade reducing from 2.33 to 0.8. The control group also improved, with R1 increasing from 9.93 to 12.6, R2 from 27.6 to 29.67, and MTS grade reducing from 2.33 to 1.4, though to a lesser extent. The study indicates that the observed improvements in plantar flexor spasticity and gait velocity in the experimental group are likely due to the synergistic effects of Myofascial Release (MFR) and conventional therapy. The mechanism of MFR is thought to involve neuro-reflexive changes, where manual pressure applied during MFR stimulates afferent receptors, leading to central processing at both the spinal and cortical levels. This stimulation results in efferent inhibition, contributing to muscle relaxation. These findings are consistent with earlier studies that highlight the effectiveness of MFR [19].

A study by Bhattacharya and Bhattacharyya (2017) compared passive stretching and MFR, finding both techniques significantly improved GMFM grade, MAS grade, and ROM (dorsiflexion). However, passive stretching proved more effective, with pre- and post-treatment mean values of 9.59±3.6 and 12.81±0.38, respectively [20].

In the Current study the control group, the pre-treatment MTS values were: R1: 9.93 ± 0.85, R2: 27.6 ± 2.03, R2-R1: 17.67 ± 1.99, and MTS Grade: 2.33 ± 0.70. Post-treatment values showed improvement with R1: 12.6 ± 1.14, R2: 29.67 ± 2.18, R2-R1: 16.8 ± 3.08, and MTS Grade: 1.4 ± 0.61. The study found that the improvements in the control group resulted from passive stretching and static weight-bearing, which help activate muscle receptors and trigger relaxation through autogenic inhibition. The significant progress observed in the control group highlights the effectiveness of both MFR and passive stretching [21].

A previous study showed significant improvements in gait parameters (stride length, step length, gait speed, and cadence) in children with cerebral palsy after four weeks of combined MFR and conventional treatment, similar to the results found in the present study [22].

Myofascial release (MFR) focused on the plantar flexors helps restore normal muscle function, increases range of motion (ROM), and improves ankle dorsiflexion. This enhances push-off, stride length, and gait velocity while promoting better ankle mobility, circulation, and muscle recovery, leading to improved walking efficiency [23].

Hence, based on the results, we reject the Null hypothesis that there is no significant difference between the Experimental and Control groups on Plantar Flexor Spasticity and Gait velocity in children with Cerebral palsy and accept the Alternate hypothesis that there is a significant difference between the Experimental and Control groups on Plantar Flexor Spasticity and Gait velocity in Children with Cerebral palsy.

Therefore, the findings of the current study emphasize the utility of combining MFR with conventional therapy in the management of plantar flexor spasticity. The significant improvements in MTS parameters and gait velocity highlight the potential of MFR as an adjunctive therapy for enhancing functional outcomes in subjects with spasticity.

CONCLUSION:

The present study concluded that Myofascial Release along with Conventional treatment was found to be more effective compared to Conventional treatment alone on Plantar flexor Spasticity and Gait velocity in Subjects with Spastic Hemiplegic Cerebral palsy.

Limitation And Recommendations:

1. The 6-week treatment period is limited; therefore, Follow-up studies are suggested to know the long-lasting effects.
2. Large sample size is recommended.
3. Studies can be conducted on different types of Cerebral palsy.
4. Research can be carried out by comparing the Modified Ashworth Scale with the Modified Tardieu Scale.

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