

Effect of kinesio taping combined with myofascial release on hamstring spasticity in children with spastic diplegic cerebral palsy: a pilot randomized controlled trial

Efeito do kinesio taping combinado com liberação miofascial na espasticidade dos isquiotibiais em crianças com paralisia cerebral espástica dipléica: um ensaio randomizado controlado piloto

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ABSTRACT | INTRODUCTION: Hamstring spasticity in children with spastic diplegic cerebral palsy (CP) contributes to knee flexion deformity and functional limitations. Evidence regarding the combined effect of kinesio taping (KT) and Myofascial Release (MFR) remains limited. **AIM:** To investigate the adjuvant effect of KT combined with MFR on hamstring spasticity. **METHODS:** A two-group pre-post pilot randomized controlled trial was conducted. Twenty-six participants were randomized; twenty completed the study (10 per group). Both groups received 60 minute therapy sessions, three times per week for two weeks. The experimental group received 10 minutes of myofascial release followed by kinesio taping and conventional therapy, while the control group received conventional therapy alone. Outcomes (MAS and knee ROM) were assessed pre-and post-intervention. Data were analysed using appropriate parametric/non parametric tests after a normality check (Shapiro–Wilk test), with the significance level set at $p < 0.05$. **RESULTS:** Both groups demonstrated significant within-group improvements in MAS and ROM ($p < 0.05$). No significant between-group differences were observed ($p > 0.05$). **CONCLUSION:** The combined intervention demonstrated short-term within-group improvements but did not show superiority over conventional physiotherapy. Larger trials are required.

KEYWORDS: Cerebral Palsy. Spastic. Physical Therapy Modalities. Athletic Tape. Myofascial Release Therapy. Randomized Controlled Trial.

TRIAL REGISTRATION: CTRI/2025/04/084469, Registered 9 April 2025, CTRI.

RESUMO | INTRODUÇÃO: A espasticidade dos isquiotibiais em crianças com paralisia cerebral espástica dipléica contribui para a deformidade em flexão do joelho e limitações funcionais. As evidências sobre o efeito combinado do kinesio taping (KT) e da liberação miofascial (LMF) ainda são limitadas. **OBJETIVO:** Investigar o efeito adjuvante do KT combinado com LMF na espasticidade dos isquiotibiais. **MÉTODOS:** Foi realizado um ensaio clínico piloto randomizado pré-pós em dois grupos. Vinte e seis participantes foram randomizados; vinte completaram o estudo (10 por grupo). Ambos os grupos receberam sessões de terapia de 60 minutos, três vezes por semana durante duas semanas. O grupo experimental recebeu 10 minutos de liberação miofascial seguidos de kinesio taping e terapia convencional, enquanto o grupo controle recebeu apenas a terapia convencional. Os desfechos (Escala de Ashworth Modificada [MAS] e amplitude de movimento do joelho) foram avaliados antes e após a intervenção. Os dados foram analisados usando testes paramétricos/não paramétricos apropriados após a verificação de normalidade (teste de Shapiro–Wilk), com o nível de significância estabelecido em $p < 0,05$. **RESULTADOS:** Ambos os grupos demonstraram melhorias significativas intragrupo em MAS e ADM ($p < 0,05$). Nenhuma diferença significativa entre os grupos foi observada ($p > 0,05$). **CONCLUSÃO:** A intervenção combinada demonstrou melhorias de curto prazo intragrupo, mas não mostrou superioridade em relação à fisioterapia convencional. Ensaio maiores são necessários.

PALAVRAS-CHAVE: Paralisia Cerebral. Espástico. Modalidades de Fisioterapia. Fita Atlética. Terapia de Liberação Miofascial. Ensaio Clínico Randomizado.

REGISTRO DO ENSAIO: CTRI/2025/04/084469, Registrado em 9 de abril de 2025, CTRI.

1. Introduction

Cerebral palsy is a prevalent movement and posture disorder causing physical disability among children¹. Cerebral palsy is caused by permanent damage to the developing immature brain before birth, at the time of birth, or just after birth².

Worldwide, the prevalence of cerebral palsy is 2.4 per 1000 children aged 3 to 10 years, while the incidence rate is 2 to 3 per 1000 live births^{2,3}. Primary neuromuscular impairments, including spasticity, muscle weakness, and decreased selective motor control, as well as musculoskeletal problems, such as bony deformities and contractures, are characteristics of cerebral palsy⁴. MRI scan abnormalities and motor dysfunctions are used to identify cerebral palsy^{1,5}. Depending on the kind of movement impacted, the body parts involved, and the area of the brain damaged, the primary forms of cerebral palsy are spastic, dyskinetic, ataxic, and mixed^{1,6}.

Spastic diplegia is the most common type of CP, accounting for 35 percent of children with CP, and is characterised by stiff, tight muscles due to increased muscle tone⁷. In diplegics, lower extremities are more spastic than the upper extremities^{8,9}. Spastic diplegics usually have increased muscle tone in adductors, calves, and the hamstring muscle groups¹⁰. Symptoms include fatigue, muscle shortness, reduced range of joint mobility, contractures, and joint subluxations⁷.

Over the years, CP has been managed using a variety of approaches, including acupuncture, neurodevelopmental training, sensory integration,

electrical stimulation, hippotherapy, music therapy, and stretching¹¹⁻¹³. One of the recent treatments is the application of kinesio taping (KT), which, in combination with other physiotherapy interventions, has been chosen for better results in this category of patients^{9,14}. A therapeutic tape called kinesio tape aids in supporting and easing joint, ligament, and muscle pain^{9,14}. The elasticity of kinesio tape lifts and tightens the skin from soft tissues when it is placed effectively^{13,15-17}.

Myofascial release (MFR) is a contemporary technique aimed at releasing tension within myofascial tissues to alleviate pain and improve movement¹⁸. MFR techniques involve gentle stretching and compressing of the fascia to target restrictions, improve mobility, and reduce pain¹⁸. The MFR technique has produced consistent results in children with cerebral palsy suffering from spasticity¹⁹.

Beyond its clinical implications, identifying effective, low-cost, and accessible interventions for spastic diplegic cerebral palsy holds significant social and economic importance, particularly in resource-limited settings. Strategies that improve mobility may enhance participation and reduce caregiver burden, while cost-effective, non-invasive techniques may lessen long-term financial strain. Furthermore, conducting a randomized controlled trial to evaluate the combined effect of myofascial release and kinesiology taping addresses an existing methodological gap in pediatric neurorehabilitation literature. This pilot randomized controlled trial aimed to evaluate the short-term adjuvant effect of KT combined with MFR on hamstring spasticity.

2. Methodology

2.1 Study design

A two-group pre-post pilot randomized controlled trial approved by the Institutional Ethics Committee, School of Health Sciences, Chhatrapati Shahu Ji Maharaj University (Kanpur) (HEC Reference Number: 2024-Jun-010). The study was registered with the Clinical Trials Registry of India (CTRI); CTRI/2025/04/084469 (CTRI). The study location was the School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh.

2.2 Participant recruitment and allocation

The inclusion criteria included: both male and female diagnosed with spastic diplegic CP; age group 4-12 years; spasticity grades 1, 1+, 2, and 3 as per the Modified Ashworth Scale on hamstrings; ambulatory children with or without ambulatory devices. The exclusion criteria included: skin sensitivity; other types of cerebral palsy; Botox injection if taken in the past six months; knee flexion contracture; and any prior orthopaedic surgery^{8,20}.

2.3 Sampling method and sample size

The sampling method used was purposive sampling. The sample size was calculated using G*Power 3.1.9.7 software with an alpha level of 0.05, a beta level of 0.80, and an effect size of 1.358,20. Considering a 30% dropout rate in the study, 26 participants were recruited.

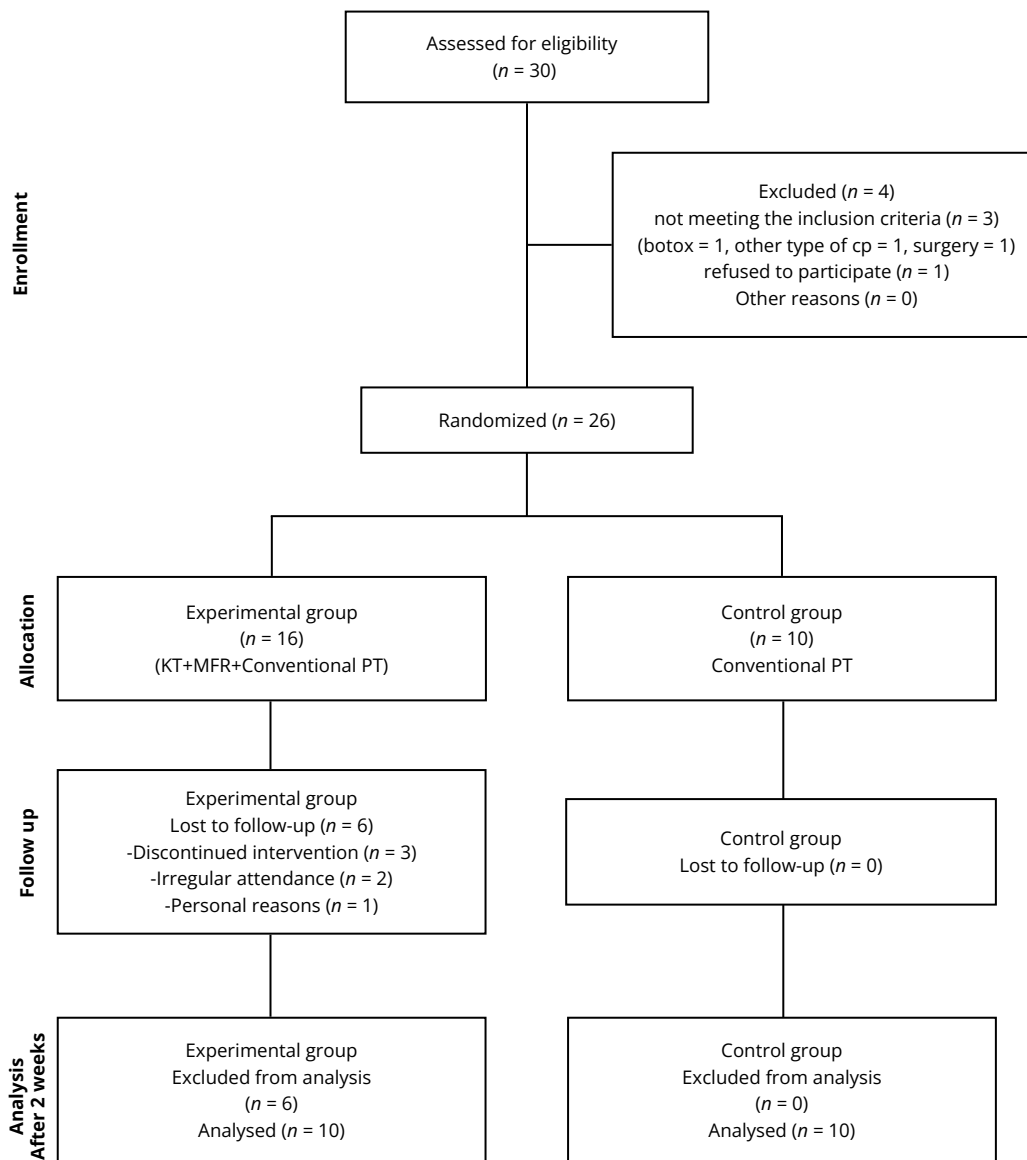
2.4 Randomization

Using a standard computerized tool (computer-generated random sequence via randomizer.org; <http://www.randomizer.org/index.htm>), children were randomly divided into the experimental and control groups after their parents provided written informed consent. The allocation sequence was generated by an independent researcher who was not involved in participant recruitment or assessment. Allocation concealment was ensured using sealed, opaque envelopes to prevent selection bias. Both the development of the unbiased allocation sequence and the process of allocation concealment were maintained in compliance with the Consolidated Standards of Reporting Trials (CONSORT) statement. The materials used in the study included kinesio tape, scissors, gel, floor mats, a stool, a gym ball, and a goniometer²⁰.

2.5 Outcome measures

The outcome measures used were the Modified Ashworth Scale (MAS) and Range of Motion (ROM)^{8,20-23}. The Modified Ashworth Scale was selected as the primary outcome measure for spasticity assessment due to its widespread clinical acceptance, easy administration, and good intrarater reliability 0.84 and good interrater reliability 0.83²⁰. Goniometry is used as a quantitative measurement tool in this study²⁰. The intratester and intertester reliability coefficients of goniometric measurement of knee joint flexion are 0.90 and 0.86, respectively, according to ICC (Intraclass Correlation Coefficient)²⁰.

Figure 1. CONSORT Flowchart of the participants



2.6 Procedures

Step 1: Every participant from the approved data source was evaluated, and those who met the inclusion criteria were recruited.

Step 2: Using a computer-generated randomization method, all individuals were divided into two groups:

- **Group A:** Conventional physiotherapy, myofascial release, and Kinesio taping;
- **Group B:** Conventional physiotherapy treatment only.

Step 3: All children’s parents were informed about the entire procedure, and their signed informed consent was obtained.

Step 4: Before and after the intervention, all subjects were assessed using the Modified Ashworth Scale (MAS) for the hamstring muscle in the prone position.

Step 5: Intervention:

Both groups received 60-minute sessions, three times per week for two weeks.

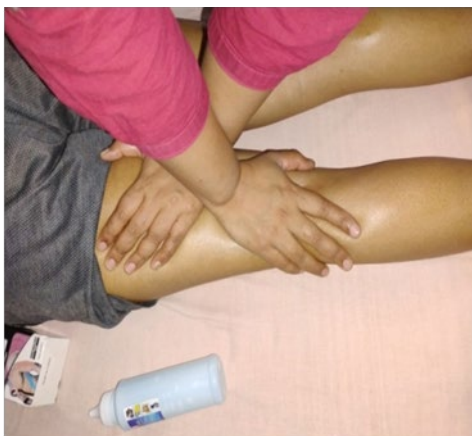
- **Experimental group (Group A):** Received 10 minutes of myofascial release (MFR) with kinesiо taping (KT) application, followed by conventional physiotherapy;
- **Control group (Group B):** Received conventional physiotherapy only.

Group A: Experimental group

Protocol for myofascial release (MFR):

Myofascial structures were stretched and held for 120 seconds while the patient was in the prone position, with the therapist's hands or thumbs crossed, allowing the tissue to soften. The procedure was conducted for a total duration of 10 minutes¹⁹.

Figure 2. Myofascial release on hamstrings



Protocol for kinesiо taping:

Taping was applied to the hamstring muscles to inhibit knee flexion. For inhibitory actions, it was applied from the end toward the beginning of the muscle (insertion to origin). An I-shaped strip was applied over the muscle belly. The tension of the tape in the muscular area was set at 30% of its original length⁸. Following MFR and kinesiо taping, all individuals received the same standard physical therapy treatment as the control group, three alternate days per week for 2 weeks.

Figure 3. Kinesiо taping on hamstrings



Group B: Control Group

Conventional physiotherapy treatment:

Children in the control group continued with passive stretching of hamstrings (10 second hold, 5 repetitions, 2 sets); weight-bearing exercises (10 repetitions); bridging (bilateral and unilateral), kneeling, sit-to-stand, one-leg standing, mini squats, and stepping (forward, backward, and sideways)-10 repetitions each, 2 sets; gait training using parallel bars (10 repetitions). There was no subdivision of time for each activity and no specific time allocation for any task.

Step 6: At the end of the second week, the effect of the intervention was assessed using MAS and a goniometer. Data for MAS were recorded and analysed using an appropriate statistical test.

2.7 Data analysis

The collected data were analysed using IBM SPSS Statistics version 26.0.0. Normality was tested with the Shapiro-Wilk test, as the sample size was less than 50. Of the outcomes, seven were normally distributed, while nine did not show a normal distribution. Statistical analysis was performed using the parametric tests (for normally distributed data), i.e., the Paired- *t* test for within-group analysis and Independent- *t* test for between-group analysis, respectively; and non-parametric tests (for non-normally distributed data), i.e., the Wilcoxon Signed

Rank test for within-group analysis and Mann-Whitney *U* test for between-group analysis, respectively. The level of significance was set at *p*-value <0.05. The demographic data were presented as mean(±SD), median (IQR), range, and *p*-value. The baseline characteristics of outcomes were expressed in terms of mean with 95%CI, median with range, and standard deviation. For primary and secondary outcomes within-group comparisons, results were expressed as mean and median with IQR for pre-and post-intervention values, along with *p*-values. The analysis of primary and secondary outcome measures was reported as median with range and *p*-value. The Post hoc power analysis was performed using G*Power 3.1.9.7, based on Cohen's *d* effect sizes presented in tables 4, 5, 6, and 7. Cohen's *d* effect sizes were calculated using pooled standard deviations for between-group comparisons. Achieved power (1-β) was computed using alpha = 0.05. Effect sizes were interpreted as small (0.2), medium (0.5), and large (≥0.8).

3. Results

Twenty-six participants were randomized, and twenty completed the study (10 per group). Six participants from the experimental group were lost to follow-up due to discontinuation or irregular attendance. Baseline demographic and clinical characteristics were comparable between groups. The demographics of participants and group distribution are depicted in Table 1, and the gender distribution of patients is depicted in Table 2. The baseline characteristics of study participants are presented in Table 3. The mean age of participants was 5.85 years (Standard Deviation was 1.80). Thirteen participants were male, and seven were female. Significant within-group improvements were observed in both groups for MAS and ROM (*p* < 0.05). However, no statistically significant between-group differences were found (*p* > 0.05), as shown in Tables 4, 5, 6, and 7. Effect size analysis demonstrated negligible-to-small effects for most MAS variables (*d* = 0–0.33), with a moderate effect observed for right knee extension (*d* = 0.69). ROM variables showed small-to-moderate effects (*d* = 0.14–0.69), particularly for the knee lacking extension. Post hoc power analysis indicated insufficient power for most MAS variables (≤0.50). Adequate power (>0.80) was observed only for the right knee lacking extension.

Table 1. Demographic characteristics of study participants (*N* = 20)

Characteristics	Mean ± SD	<i>p</i> -value
Age	5.85 ± 1.80	< 0.001
Weight	15.41 ± 4.61	0.12
Height	103.30 ± 13.11	0.17
Group (experimental and control)	1.50 ± 0.513	< 0.001

Table 2. The frequency and percentage of the gender distribution

Gender	Frequency (<i>N</i>)	Percentage (%)	<i>p</i> -value
Male	13	65	< 0.001
Female	7	35	
Total	20	100	

Table 3. Baseline characteristics of study participants

Variables	Mean (95% CI)	SD	Median (Range)	p-value
MAS LKF Pre	1.67 (1.56-1.79)	0.24	1.50 (2-1.5)	< 0.001
MAS LKE Pre	1.85 (1.73-1.92)	0.23	5.00 (11.0-2.0)	< 0.001
ROM LKF Pre	113.33 (109.80-116.85)	7.52	112.50 (125.0-98.5)	0.61
ROM LKLE Pre	6.52 (5.17-7.87)	2.89	5.00 (11.0-2.0)	0.02
MAS RKF Pre	1.70 (1.58-1.81)	0.25	1.50 (2.0-1.5)	< 0.001
MAS RKE Pre	1.82 (1.71-1.94)	0.24	2.00 (2.0-1.5)	< 0.001
ROM RKF Pre	113.37 (110.43-116.31)	6.28	112.20 (123.0-100.0)	0.43
ROM RKLE Pre	6.50 (5.22-7.77)	2.71	5.50 (10.5-2.0)	0.09

Abbreviations: SD - Standard Deviation, MAS - Modified Ashworth Scale, LKF - Left Knee Flexion, LKE - Left Knee Extension, ROM - Range of Motion, LKLE - Left Knee Lacking Extension, RKF - Right Knee Flexion, RKE - Right Knee Extension, RKLE -Right Knee Lacking Extension.
Note: p-value less than 0.05 shows significance.

Table 4. Within-group changes in Modified Ashworth Scale (MAS)

Variable	Group	Pre (Mean ± SD)	Post (Mean ± SD)	Mean difference	p-value
Left knee flexion	Experimental	1.70 ± 0.25	1.20 ± 0.25	-0.50	<0.001
	Control	1.65 ± 0.24	1.20 ± 0.25	-0.45	<0.001
Left knee extension	Experimental	1.80 ± 0.25	1.20 ± 0.25	-0.60	<0.001
	Control	1.90 ± 0.21	1.30 ± 0.34	-0.60	<0.001
Right knee flexion	Experimental	1.70 ± 0.25	1.20 ± 0.25	-0.50	<0.001
	Control	1.70 ± 0.25	1.20 ± 0.25	-0.50	<0.001
Right knee extension	Experimental	1.80 ± 0.25	1.15 ± 0.24	-0.65	<0.001
	Control	1.85 ± 0.24	1.35 ± 0.33	-0.50	<0.001

Table 5. Between-group comparison of post-intervention MAS

Variable	Experimental	Control	Mean difference	Cohen's d	Post hoc Power	p-value
Left knee flexion	1.20 ± 0.25	1.20 ± 0.25	0.00	0.00	0.05	1.00
Left knee extension	1.20 ± 0.25	1.30 ± 0.34	-0.10	0.33	0.50	0.54
Right knee flexion	1.20 ± 0.25	1.20 ± 0.25	0.00	0.00	0.05	1.00
Right knee extension	1.15 ± 0.24	1.35 ± 0.33	-0.20	0.69	0.96	0.15

Table 6. Within-group changes in knee range of motion (degrees)

Variable	Group	Pre (Mean ± SD)	Post (Mean ± SD)	Mean difference	p-value
Left knee flexion	Experimental	112.81 ± 8.02	118.94 ± 5.82	+6.13	<0.001
	Control	113.85 ± 7.38	118.04 ± 6.66	+4.19	<0.001
Left knee lacking extension	Experimental	6.55 ± 2.91	2.70 ± 2.58	-3.85	<0.001
	Control	6.50 ± 3.02	4.30 ± 2.90	-2.25	<0.001
Right knee flexion	Experimental	112.00 ± 7.04	118.15 ± 5.09	+6.15	<0.001
	Control	114.75 ± 5.44	118.50 ± 5.27	+3.75	<0.001
Right knee lacking extension	Experimental	6.30 ± 2.98	2.70 ± 2.75	-3.60	<0.001
	Control	6.70 ± 2.57	4.29 ± 2.78	-2.41	<0.001

Table 7. Between-group comparison of post-intervention ROM

Variable	Experimental	Control	Mean difference	Cohen's d	Post hoc Power	p-value
Left knee flexion	118.94 ± 5.82	118.04 ± 6.66	0.90	0.14	0.18	0.75
Left knee lacking extension	2.70 ± 2.58	4.30 ± 2.90	-1.60	0.58	0.89	0.63
Right knee flexion	118.15 ± 5.09	118.50 ± 5.27	-0.35	0.07	0.10	0.88
Right knee lacking extension	2.70 ± 2.75	4.29 ± 2.78	-1.59	0.57	0.88	0.21

4. Discussion

To prevent knee contractures and enhance knee extension range of motion (ROM) in children with diplegic spastic cerebral palsy, this randomized controlled trial (RCT) examined the effectiveness of kinesio taping and myofascial release interventions on hamstring spasticity. In this study, we focused on hamstring muscles due to their major involvement in knee flexion deformity, flexion contracture, and reduced knee extension. The results suggest significant within-group improvements in spasticity and knee range of motion were observed in both groups; however, no statistically significant between-group differences were found two weeks after the intervention.

A key finding was the comparatively larger effect sizes for knee extension and knee lacking extension variables than for knee flexion parameters. Moderate effect sizes were observed for right knee extension on MAS ($d = 0.69$) and for ROM lacking extension ($d = 0.57$ – 0.58), whereas flexion outcomes demonstrated negligible-to-small effects ($d = 0$ – 0.14). Post hoc power was also higher for extension-related variables (0.88–0.96), indicating greater sensitivity to detect moderate effects.

This pattern is clinically plausible. In spastic diplegic cerebral palsy, hamstring spasticity primarily restricts terminal knee extension rather than flexion range^{4,24}. Because both MFR and KT were applied directly to the hamstrings, their inhibitory and mechanical effects are more likely to reduce resistance during passive extension, when the muscle is maximally stretched⁷. The Modified Ashworth Scale assesses resistance to passive movement; thus, reductions in hypertonicity would be more apparent during extension than flexion.

MFR may decrease fascial stiffness and improve tissue extensibility, particularly at end range, while KT applied from insertion to origin may provide inhibitory sensory input and modulate neuromuscular activation^{8,18,25}. These mechanisms may explain the observed improvements in extension-related outcomes; however, since no significant between-group differences were found, these effects cannot be attributed specifically to the combined intervention. In contrast, knee flexion range is often relatively preserved in this population, potentially creating a ceiling effect that limits measurable improvement²⁴.

This study shows similarity with the findings of Rasool et al. who reported that spasticity among CP children could be reduced by cross-friction massage when added to conventional physiotherapy²⁶. Likewise, Tikhile et al. demonstrated that the combined effect of cryotherapy and myofascial stretching helped in reducing spasticity in calf muscles and improved ankle ROM¹⁰. Our findings are consistent with previous studies reporting improvements following myofascial release and other adjunct therapies; however, in the present study, these improvements were observed within groups, and no additional benefit over conventional therapy alone was demonstrated^{12,18,20}.

A study done by Kaya Kara et al. demonstrated that the kinesio taping technique could enhance proprioceptive feedback and gross motor function in children with unilateral spastic cerebral palsy²⁷. Previous studies have reported improvements in GMFM, gait parameters, and other outcomes with Kinesio taping; however, the present study did not demonstrate superior effects compared to conventional therapy alone^{14,15,28-32}.

Tabatabaee et al. found no improvements in balance following a two-day taping intervention; however, they reported positive effects after a two-week intervention³³. Although previous meta-analyses have reported positive effects of Kinesio taping on functional capacity, the present study did not demonstrate statistically significant superiority of the combined intervention over conventional therapy¹⁷.

Post hoc power analysis revealed that most MAS variables had low achieved power (≤ 0.50), suggesting that the study was underpowered to detect small between group effects. Although moderate effect sizes were observed for certain ROM variables, only right knee lacking extension demonstrated adequate power (> 0.80).

The absence of statistically significant between-group differences may be influenced by the small sample size; however, based on the current findings, superiority of the combined intervention over conventional therapy cannot be concluded.

The findings are limited to children with spastic diplegic cerebral palsy within the specified age range included in this study. Extrapolation to other cerebral palsy subtypes, age groups, or functional levels should be undertaken cautiously, and broader studies are needed to enhance external validity. Future large scale randomized controlled trials with adequate power are required to confirm these findings.

These results suggest that both groups demonstrated improvements over time; however, the addition of myofascial release and Kinesio taping did not result in superior outcomes compared to conventional physiotherapy alone.

This study has limitations. Due to the small sample size, short intervention duration (two weeks) and no long-term follow-up limiting the generalizability of the findings. Assessment was restricted to the hamstrings muscle group in children with cerebral palsy, while other spastic muscle groups were not evaluated. Spasticity was measured using the Modified Ashworth Scale, which does not differentiate between neural and biomechanical components. Functional outcome measures such as the Gross Motor Function Measure were not included, and Gross Motor Function Classification System levels were not reported. Due to the nature of the intervention, therapists and participants could not be blinded, and assessor blinding may also have been compromised. An intention-to-treat analysis was not performed, which may limit the robustness of the findings. Future definitive trials should incorporate intention-to-treat principles to minimize attrition bias and strengthen methodological rigor.

5. Conclusion

This pilot randomized controlled trial demonstrated that both conventional therapy alone and conventional therapy combined with kinesio taping and myofascial release resulted in significant within-group improvements in hamstring spasticity and knee range of motion. However, no statistically significant between-group differences were observed.

These findings indicate that improvements occurred in both groups; however, the combined intervention did not demonstrate superior short-term benefits compared to conventional therapy alone. Larger, adequately powered trials with longer follow-up periods are required to confirm these preliminary findings. Therefore, the findings of this study should be interpreted as evidence of within-group improvement rather than superiority of the combined intervention.

Data availability statement

Data will be made available upon request through the corresponding author. Dataset available at the Mendeley depository. doi: [10.17632/zg2xhgpt9d.1](https://doi.org/10.17632/zg2xhgpt9d.1).

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Authors' contributions

The authors declared that they have made substantial contributions to the work in terms of the conception or design of the research; the acquisition, analysis or interpretation of data for the work; and the writing or critical review for relevant intellectual content. All authors approved the final version to be published and agreed to take public responsibility for all aspects of the study.

Competing interests

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) were declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

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