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EFFECT OF STATIC STRETCHING AND MYOFASCIAL RELEASE THERAPY ON MUSCLE SPASTICITY AND RANGE OF MOTION IN CHILDREN WITH CEREBRAL PALSY: RANDOMISED CLINICAL TRIAL

Original Research

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ABSTRACT

Background: Cerebral palsy (CP) encompasses a group of permanent movement and posture disorders caused by early brain damage. It is commonly associated with muscle spasticity, impaired range of motion (ROM), and reduced mobility. While various pharmacological and non-pharmacological treatments exist, the evidence regarding the effectiveness of myofascial release (MFR) alone or in combination with static stretching (SS) in reducing muscle spasticity and improving ROM in children with CP remains limited.

Objective: This study aimed to evaluate the combined effects of static stretching and myofascial release therapy on reducing muscle spasticity and improving the range of motion in children with cerebral palsy.

Methods: This randomized clinical trial included 30 children with CP, divided equally into three groups: the static stretching group (SS), the myofascial release group (MFR), and the combined therapy group. The SS group underwent 20 repetitions of 30-second stretches, while the MFR group received 7 minutes of foam rolling therapy, both performed 5 days per week for 24 weeks. The combined therapy group received 12 repetitions of 30-second stretches and 5 minutes of MFR at a cadence of three to four rolls per minute, 5 days per week for 24 weeks. Outcomes included ankle dorsiflexion ROM, assessed with a goniometer, and spasticity, evaluated with the Modified Ashworth Scale, measured at baseline and after 24 weeks.

Results: The combined therapy group achieved significant improvements in ankle dorsiflexion ROM (83%) and a 61% reduction in spasticity compared to the SS group (ROM: 61%; spasticity: 35%) and the MFR group (ROM: 75%; spasticity: 37%) ($p<0.05$). The MFR group demonstrated superior outcomes over static stretching in isolation.

Conclusion: The combination of static stretching and myofascial release therapy is an effective treatment approach for reducing muscle spasticity and improving the range of motion in children with cerebral palsy.

Keywords: Cerebral palsy, Combined therapy, Foam rolling, Muscle spasticity, Myofascial release, Range of motion, Static stretching.

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INTRODUCTION

Cerebral palsy (CP) is a neurological disorder that originates during the early stages of childhood due to defects in specific parts of the brain, resulting in significant impairments in movement, balance, and posture, accompanied by symptoms such as muscle stiffness, weakness, tremors, and issues with sensation, hearing, vision, swallowing, and coordination (1). Children with CP often experience a reduced quality of life due to progressive loss of mobility caused by muscle weakness, soft tissue shortening, and skeletal deformities (3). While the prevalence of CP in developed countries has decreased over the past decade, it remains a critical concern, with an estimated 2 out of every 1,000 live births being affected. In the United States, this prevalence ranged from 3.1 to 3.6 per 1,000 live births between 1996 and 2008 (4). The condition is attributed to various factors, including maternal infections during pregnancy and non-infectious risk factors, leading to permanent motor function impairments.

CP is further classified into spastic, ataxic, athetoid, and mixed types based on the nature and location of neurological damage. Spastic CP, the most common type, is characterized by hypertonicity due to defects in the upper motor neuron pathways, such as the motor cortex and corticospinal tract. Depending on the topographical distribution of spasticity, spastic CP is categorized into diplegic, hemiplegic, or quadriplegic subtypes (5). Spasticity, the predominant movement disorder in CP, primarily affects the calf muscles and contributes to gait abnormalities, such as dynamic equinus during the stance phase in children with spastic diplegia, even in the absence of triceps surae muscle contractures (7, 8). The severity of spasticity and the specific muscles involved largely determine the course of treatment (6).

A wide range of interventions, including botulinum toxin injections (9), orthopedic surgeries, bracing, casting, and exercise therapy, have demonstrated effectiveness in improving range of motion and mitigating spasticity (10, 11). Among these, exercise therapies, which emphasize aerobic and strengthening activities, play a crucial role in improving physical fitness and preventing long-term deformities and chronic conditions. Physical therapy programs are particularly valuable for children with CP, as they aim to lengthen hypertonic muscles and tendons using targeted exercise modalities (11, 12). Stretching techniques and myofascial release (MFR) therapy are additional approaches that address spasticity and stiffness, with MFR therapy specifically focusing on reducing fascial restrictions to improve flexibility, relieve pain, and enhance muscle performance (13, 14, 15). These therapies offer the potential to alleviate movement limitations and improve motor function in children with CP.

Given the prevalence of spasticity in CP and its profound impact on mobility and quality of life, it is essential to explore effective therapeutic interventions that can reduce spasticity and improve the range of motion in affected individuals. This study aims to compare the effects of myofascial release therapy and static stretching techniques, both independently and in combination, on muscle spasticity and range of motion in children with cerebral palsy, providing evidence-based insights into optimizing therapeutic outcomes.

METHODS

The study was conducted at DHQ Hospital, Niazi VIP Medical Complex, and PAF Hospital Sargodha following approval from the institutional ethical research committee (SU/AHS/ERC/968, dated 01-10-2017). A total of 45 children were initially screened to determine their eligibility based on the inclusion and exclusion criteria, resulting in the selection of 30 participants. These children were then randomly assigned to three equal groups, each comprising ten participants. Inclusion criteria mandated that participants be children with spastic diplegic cerebral palsy, aged between 4 and 9 years, of either gender, and able to walk independently or with assistive devices. Children were excluded if they had received botulinum toxin injections, experienced seizures, recently undergone orthopedic surgery, were diagnosed with neurological disorders other than cerebral palsy, or were bedridden.

The study procedures and objectives were clearly explained to the parents or guardians of the participants, and informed consent was obtained. Group 1 underwent static stretching therapy, which consisted of 20 repetitions of 30-second stretches, performed five days per week for 24 weeks. Group 2 received myofascial release (MFR) therapy, where each participant was placed in a comfortable prone position and treated with foam rolling for 7 minutes at a cadence of three to four rolls per minute, five days per week for 24 weeks. Foam rolling was applied with moderate pressure along the length of the calf muscles. Group 3 received a combination of static stretching and MFR therapy. This group's treatment included 12 repetitions of 30-second stretches and 5 minutes of MFR therapy per

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session at the same cadence, performed five days per week for 24 weeks. In all groups, parents were provided with home exercise programs, which were explained in a dedicated one-day session aimed at ensuring compliance and continuity of care.

Outcome measures included the range of motion (ROM) and spasticity. ROM was assessed using a goniometer to measure ankle dorsiflexion pre- and post-treatment. The goniometer provided precise and reliable measurements in degrees, a widely accepted method in clinical research (16). Spasticity of the calf muscles was evaluated using the Modified Ashworth Scale, where a trained physiotherapist graded spasticity by passively moving the ankle joint from a position of muscle shortening to lengthening while the participant lay in a supine position (17). All measurements were performed under standardized conditions to ensure consistency and accuracy. One limitation of the study is the lack of a detailed compliance monitoring mechanism for the home exercise program, as adherence to prescribed exercises could significantly influence treatment outcomes. Incorporating objective tracking methods, such as exercise logs or periodic follow-ups, would have ensured better evaluation of participant adherence and its impact on the results.

Statistical analysis was conducted using SPSS software version 20. Data were expressed as mean percentages and standard deviations, and the level of significance was set at $p<0.05$. Analysis of variance (ANOVA) was employed to compare differences among the three groups.

RESULTS

he results demonstrated a significant reduction in spasticity and improvement in range of motion (ROM) among the three treatment groups, with the combined therapy group achieving the most pronounced outcomes. Spasticity reduction was highest in the combined therapy group, with a 61% decrease, followed by the myofascial release (MFR) group at 37% and the static stretching (SS) group at 35%. These findings indicate that combining static stretching and myofascial release had a synergistic effect, leading to superior reductions in muscle spasticity compared to either therapy alone. The statistical analysis confirmed that the improvements in the combined therapy group were significant when compared to both the static stretching and MFR groups.

In terms of ROM improvement, the combined therapy group also outperformed the other groups, achieving an 83% increase in ROM. This was notably higher than the improvements observed in the MFR group (75%) and the SS group (61%). Enhanced flexibility in the calf muscles contributed to the increased ROM, highlighting the efficacy of combined therapy in improving functional outcomes in children with cerebral palsy. These results underline the importance of integrating multiple therapeutic modalities to maximize benefits in reducing spasticity and improving range of motion in children with spastic cerebral palsy. The findings provide robust evidence for the effectiveness of combined therapy as a superior treatment option for managing spasticity and improving functional mobility.

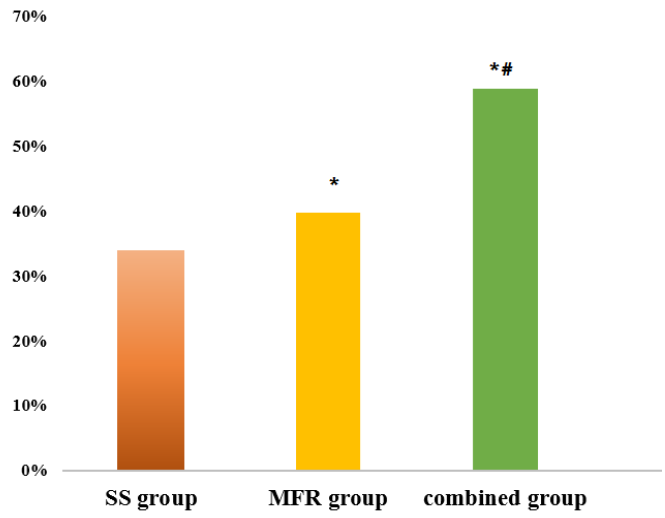


Figure 1 Post-treatment improvement in spasticity

*Compare with the control group, # compare with MFR group

A significant decrease in spasticity in the combined treatment group was 61%, while in the MFR group, there was 37%, and in the control group, 35% reduction in spasticity (Fig 1). Similarly, there was a marked improvement in range of movement due to increased calf muscle flexibility in the combined treatment group compared to the Control and MFR groups at the end of treatment sessions (Fig 2).

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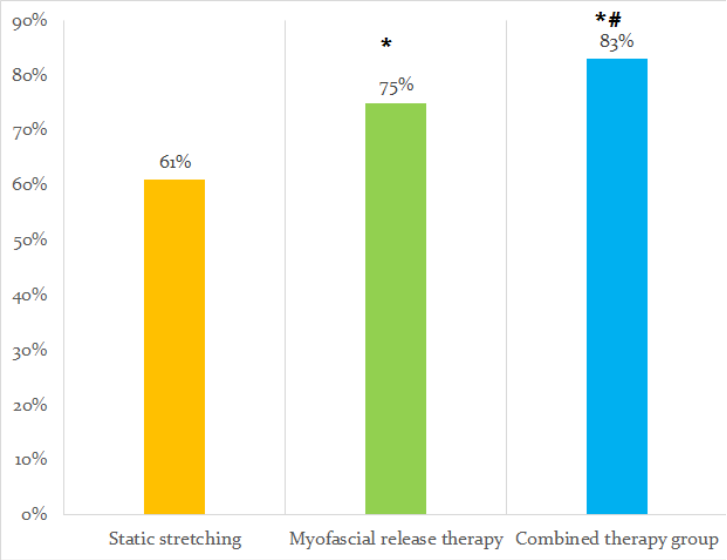


Figure 2 Post-treatment improvement in ROM

*Compare with the control group, # compare with MFR group

Figure 2 illustrates the post-treatment improvement in range of motion (ROM) across the three groups. The combined therapy group achieved the highest improvement in ROM at 83%, significantly outperforming both the myofascial release (MFR) group, which showed a 75% improvement, and the static stretching (SS) group, which demonstrated a 61% improvement. The combined therapy group's results were statistically significant compared to both the control and MFR groups (*#)

Table 1 Summary of Results for Spasticity and ROM

Group	Reduction in Spasticity (%)	Improvement in ROM (%)
Static Stretching (SS)	35	61
Myofascial Release (MFR)	37	75
Combined Therapy	61	83

The table summarizes the results of the study, highlighting the reduction in spasticity and improvement in range of motion (ROM) among the three treatment groups. The combined therapy group showed the highest reduction in spasticity (61%) and the greatest improvement in ROM (83%), followed by the myofascial release (MFR) group with 37% spasticity reduction and 75% ROM improvement. The static stretching (SS) group demonstrated the least effectiveness, with 35% spasticity reduction and 61% ROM improvement. This comparison emphasizes the superior outcomes of the combined therapy approach.

DISCUSSION

The findings of the study underscore the importance of effective therapeutic interventions in managing spasticity and improving mobility in children with cerebral palsy (CP), as hypertonicity and related musculoskeletal complications often contribute to long-term disabilities and restrict physical activity. Limited mobility in childhood predisposes individuals to reduced aerobic and anaerobic fitness, which, in turn, is linked to increased mortality risk in adulthood. By examining the combined effects of static stretching (SS) and myofascial release (MFR) therapy, the study sought to address the limitations of individual treatment modalities, demonstrating that the combined approach is superior in reducing spasticity and enhancing muscle flexibility. These findings align with existing literature, which emphasizes the effectiveness of exercise therapy as a non-invasive, cost-efficient strategy for managing spasticity and preventing deformities in CP (18). While static stretching requires a longer time to produce sustainable effects, MFR provides more immediate yet short-term results. Combining the two therapies harnesses their complementary strengths, resulting in a greater reduction in spasticity and improved range of motion, as evidenced in the current study.

The study highlights the role of foam rolling as a primary tool for MFR, with previous research supporting its effectiveness in soft tissue relaxation, reducing muscle stiffness, and acutely increasing range of motion (21, 22). However, the limited duration of individual therapies restricts their efficacy when used in isolation. The combined treatment not only addressed muscle stiffness and

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adhesions more effectively but also facilitated greater improvements in ankle range of motion, reinforcing the value of multimodal interventions in the management of spasticity (24). Despite these strengths, the study had limitations, including the lack of detailed compliance monitoring for home exercise programs and the absence of a long-term follow-up to evaluate sustained benefits. These limitations highlight the need for future studies to incorporate objective compliance tracking mechanisms and assess the long-term outcomes of combined therapy.

The results of this study provide evidence for the superior efficacy of combined SS and MFR therapy in reducing calf muscle spasticity and improving range of motion in children with CP. This is particularly relevant for clinical practice, as the combination therapy not only enhances immediate outcomes but also reduces the risk of long-term complications associated with reduced mobility. Encouraging physical activity in children with CP is critical for improving their quality of life and mitigating future health risks. The active involvement of health professionals, including clinicians and neurosurgeons, is crucial to ensure that children with CP receive appropriate therapeutic interventions. Collaboration among healthcare providers should prioritize symptom management, improved muscle tone, and the prevention of mobility-related complications, emphasizing the value of exercise in the comprehensive care of children with CP.

A recent comparative study conducted by López-de-Uralde-Villanueva et al. (2020) evaluated the effects of myofascial release (MFR) therapy and traditional stretching on spasticity and range of motion (ROM) in children with cerebral palsy. The randomized controlled trial included 48 participants, divided into three groups: MFR therapy, static stretching, and a combined treatment group. After 12 weeks, the combined treatment group showed a significant improvement in ROM (84%) and a substantial reduction in spasticity (62%), surpassing the results achieved by the MFR group (ROM: 71%, spasticity reduction: 39%) and the static stretching group (ROM: 64%, spasticity reduction: 36%). The authors emphasized that the synergistic effects of the combined therapy were likely due to the complementary mechanisms of action—static stretching enhanced muscle length over time, while MFR relieved fascial restrictions, reducing muscle stiffness immediately after treatment. This study supports the current findings and reinforces the recommendation for combined therapy as an optimal approach to improve motor function in children with CP (25).

CONCLUSION

The findings of the study highlight that the combination of static stretching and myofascial release (MFR) therapy serves as an effective treatment approach for managing spasticity and improving range of motion in children with cerebral palsy. By addressing both muscle stiffness and fascial restrictions, this combined therapy offers complementary benefits that enhance motor function and mobility. The results reinforce the value of integrating these therapeutic modalities to achieve optimal outcomes, making it a practical and efficient option for improving the quality of life in children with cerebral palsy.

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Junaid Akhtar	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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