

The Impact of Myofascial Release Therapy and Deep Oscillation Therapy on Hamstring Muscle Length and tone in Children with Spastic Cerebral Palsy: A Comparative Study

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ABSTRACT

BACKGROUND: As a result of restricted joint range of motion due to spasticity in patients with spastic cerebral palsy, the patient's ability to regain normal functioning may be hindered.

PURPOSE: To evaluate the effectiveness of Myofascial Release Therapy (MFR) versus Deep Oscillation Therapy (DOT) in helping children with spastic cerebral palsy to relax and extend their hamstring range of motion.

METHODOLOGY: A total of 32 individuals with spastic cerebral palsy, aged 2 to 10, were recruited for this comparative experimental study through a method of random sampling. Sixteen subjects were assigned to each group. Group 1 (N=16) received two sessions of MFR with conventional exercise per day, whereas Group 2 (N=16) received a single session of DOT with conventional exercise per day. Throughout the course of four weeks, both groups got therapy five days per week. A universal goniometer was used to compare the knee extension passive range of motion (PROM), active range of motion (AROM), and Popliteal angle (POP angle) measurements between the pre- and post-treatment periods. Statistical analyses were conducted using ANOVA 2x2 and Post hoc tables.

RESULT: Both groups' post-mean values for each of the dependent variables (AROM, PROM, and POP angle) statistically improved ($p < 0.05$). Both groups' mean differences in the PROM and POP angles were statistically significant, and Group 1's spastic hamstring muscle was more improved than Group 2's, but both groups' AROM showed almost equal improvement.

CONCLUSION: In children with spastic cerebral palsy, both MFR and DOT, when combined with conventional therapy, reduce spasticity and increase length (AROM & PROM) in the hamstring muscle. However, our study clearly shows that MFR is more successful than DOT.

Keywords: Myofascial release, Deep Oscillation Therapy, Spastic Hamstring muscle, Spastic cerebral palsy, passive range of motion

INTRODUCTION

“Non-progressive but not unchanging disorder of movement and/or posture, caused by an injury or anomaly of the developing brain,” is how Cerebral Palsy is defined. A range of

disorders characterized by motor dysfunction brought on by non-progressive brain injury inflicted early in infancy are together referred to as cerebral palsy. Brain injury can be caused by a variety of factors, such as abnormal brain

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development, anoxia, intracranial bleeding, severe neonatal asphyxia (hypoxic ischemic neonatal encephalopathy), trauma, hypoglycemia, viruses, and other illnesses. In every instance, the insult targets an immature neurological system, and the damaged nervous system causes the immature nervous system to continue developing [1]. Spasticity, a feature of higher motor neuron lesions, is frequently brought on by damage to descending pathways and results in a variety of motor and sensory abnormalities [2]. The increase in the muscle's velocity-dependent joint resistance to passive motion is known as spasticity. Spasticity is a serious condition that can have negative effects on one's ability to function, including pain [3]. In spasticity, the loss of supraspinal control of descending pathways that control excitatory and inhibitory influences on proprioceptive, cutaneous, and nociceptive spinal reflexes is typically the cause of the primary deficits brought on by an upper motor neuron lesion (UMNL).

According to its definition, MFR is "the facilitation of mechanical, neural, and psychophysiological adaptive potential as interfaced by the myofascial system".⁴ This is accomplished by altering the viscosity of the ground substance of the fascia, stretching the cross-links and the muscle elastic fascia components.^[5]

A restricted tissue barrier is going to experience histological length alterations as a result of prolonged pressure, according to the MFR. A sense of perceptible release is felt after 90–120 seconds, and the tissue becomes softer and flexible [6]. According to some study, MFR is a specialized, supplemental technique to loosen and realign muscles and may help young children with spastic CP improve their motor function.

A low-intensity electrical current is delivered at various frequencies in deep oscillation, a relatively recent therapeutic method. When it used manually, an intermittent electrostatic field arises between the practitioner's hands and the subject's tissues, resulting in a penetrating vibratory action that removes excess fluid or adhesions deep inside the tissue. The deep oscillation may change interior tissue temperatures or trigger nerve endings to increase the flexibility of soft

tissues as it moves the fluid. By these mechanics, it improves the length of tighten muscles. DOT, however, isn't considered as a thermal modality [7]. Patient compliance is frequently high, and outcomes are frequently positive because DOT has not been associated with any side effects or discomfort, even though it is a new device, it is safe for application.⁸

The mechanism of DOT may be similar to whole body vibration (WBV) because it creates a vibration effect. Some studies report that after receiving treatment, the WBV group's gross motor function improved and their degree of knee extensor stiffness dramatically decreased.

AIM OF THE STUDY

There are several ways to reduce spasticity, but in this particular instance, we focused on novel treatments for the spastic hamstrings. We chose the hamstring muscle because it frequently impact CP children's walking patterns. This study assesses how DOT and MFR affect children with spastic CP in terms of reducing hamstring muscle stiffness and improving knee extension active and passive ROM.

METHODOLOGY

A total of 32 subjects (detail mentioned in Figure 1/flow chart of study design) were randomly assigned into Group 1 (MFR and Conventional therapy) 16 subjects and Group 2 (DOT and Conventional therapy) 16 subjects who met the inclusion criteria, and then parents or caregivers of the patients were asked to sign the informed consent form. They received verbal instructions in detail for the investigation.

Inclusion criteria

Patients must meet the following criteria to be included: Age range from 2 to 10 years, all sexes, TARDIEU scales "Quality of muscle reaction 1-4", participants who can move around on their own or with ambulatory assistance and popliteal angle less than 60°.

Exclusion criteria

Patients who have undergone or anticipate undergoing orthopedic surgery, received a

botulinum toxin injection within the past six months, had recent serial casting within last six months, used orally or intravenously administered myorelaxants, and have any cognitive or perceptual disorders are excluded from the study.

Outcome measures

- Active Range of Motion (AROM)
- Passive Range of Motion (PROM)
- Popliteal angle (POP angle): It assesses the tone of the hamstring muscle.

Measurement Tool

1. The Tardieu Scale-

Spasticity is assessed using the Tardieu scale, which considers resistance to passive movement at both slow and high rates. It takes into account the muscular reaction's quality, speed, and angle (Morris, 2002). The Tardieu Scale, which distinguishes between contracture and spasticity, shows enduring validity.

2. Universal Goniometer

In the present study, goniometry is used as a quantitative measurement tool. According to studies, the goniometric measurement of knee joint flexion's intratester and intertester reliability are 0.90 and 0.86, respectively, according to the ICC (Interclass Correlation Coefficient).

Intervention

Group 1 (16 samples) - (MFR + Conventional therapy)



Fig. 2: Application of Myofascial Release Therapy/MFR.

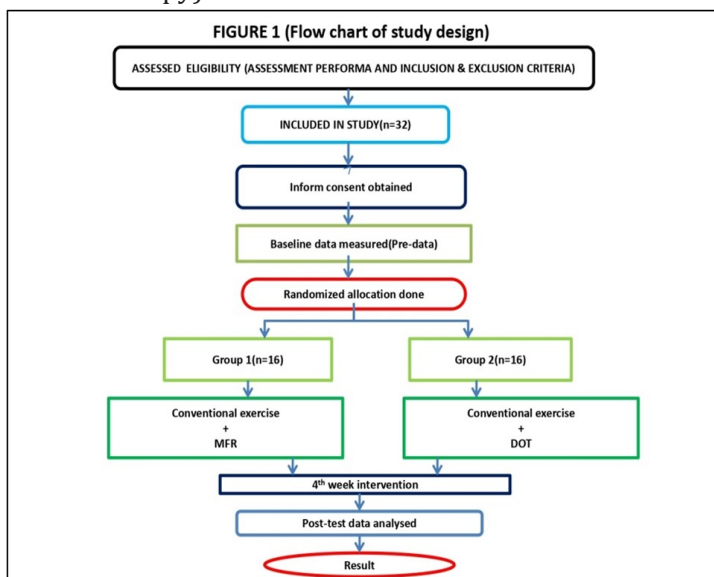
The subject was in prone standing with the upper trunk supported by the chest arm component of the segmental mobilization bed and foot touch to the ground with the knee supported by one hand of the therapist, tried to extend to the full extent (Figure 2). The therapist was sitting on a bench behind the child and releasing the hamstring muscle from origin to insertion by using the thumb or heel of the other hand for 5 minutes, twice daily, five days per week, and four weeks total. Conventional exercises were provided.

Group 2 (16 samples) - (DOT + Conventional therapy)

The client's Position was the same as above, and the therapist was behind the client, applying DOT to the spastic hamstring muscle with a handheld applicator (Figure 3). The DOT machine's electrical current is programmed to oscillate for the first 10 minutes at a frequency of 150 Hz, then for the final 5 minutes at a frequency of 60 Hz (a total of 15 minutes) at an output of 80- 100%. The intervention was applied once daily for five days per week and 4 weeks total. Conventional exercises were also provided.

Conventional therapy

The conventional exercises include bridging (unilateral and bilateral), half-kneeling to standing, sitting to standing, standing on one leg and stepping (forward, backward, and sides), as well as functional stretching for all tight structures. These are applied five days per week by therapists in the physiotherapy department.



DATA COLLECTION

Prior to starting the treatment programme, measurements were obtained, and they were done again once it was finished. Subjects were tested on all the dependent variables. The outcome measures (Knee AROM, Poplital angle and PROM) were measured and mentioned in degree (0) in this study by using universal goniometer. Collected data was transcribed onto a data sheet for each subject separately. The ethical committee of the Institute gave its permission prior to the study's implementation.

DATA ANALYSIS

The study's collected data were statistically analyzed using Microsoft Office Excel 2007 and SPSS version 25.0 (Statistical Package for Social Sciences) for Windows. The dependent variables

were analyzed using 2x2 ANOVA. There was one within factor (time) with two levels (Pre-test, Post-test) and one between factor (group) with two levels (Groups: MFR and DOT). The statistical level of significance for all pairwise Post-hoc comparisons was set at alpha=0.05.

RESULTS

KNEE EXTENSION PROM

After receiving therapy for four weeks, both groups showed improvements in knee extension PROM in the supine position, as shown in Figure 4(Graph: PROM of knee extension). In the post-treatment evaluations, Group 1 (MFR) significantly improved more than Group 2 (DOT). There was a major effect for time F (60.688), df(1), p=0.000, according to the ANOVA (TABLE 1).



Fig. 3 : Application of Deep Oscillation Therapy/DOT.

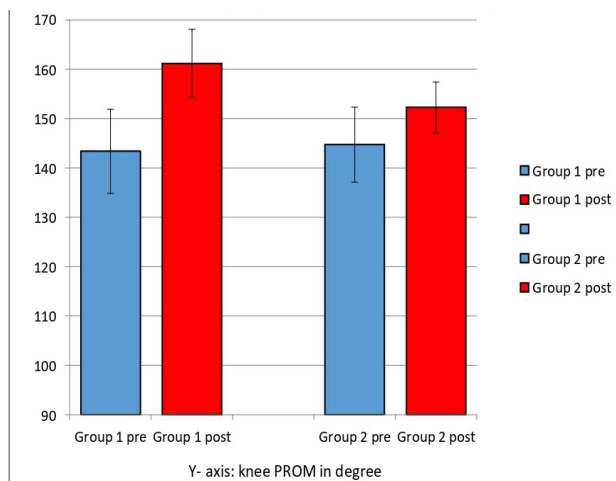


Fig. 4 : Graph Knee Extension PROM

ANOVA (TABLE 1)						
FOR KNEE PASSIVE RANGE OF MOTION						
Test of between and within subject effect						
BETWEEN SUBJECT EFFECT		SUM OF SQUARES	Df	MEAN SQUARE	F	SIGNIFICANCE
	Group	225.000	1	225.000	3.730	0.063
	Error	1809.437	30	60.315		
WITHIN SUBJECT EFFECT	Time	2575.562	1	2575.562	60.688	0.000
	Time x Group	420.250	1	420.250	9.902	0.004
	Error	1273.188	30	42.440		

Group F (3.730) did not have a main effect; $df(1) p=0.063$

The primary effects were qualified into the time group interaction, $F(9.902), df(1),$ and $p=0.004$. Tukey's Post Hoc analysis revealed that both groups had significantly improved. At the end of the course of treatment, MFR was more efficient to DOT.

POPLITEAL ANGLE

After receiving treatment for four weeks, Figure 5 (Graph: knee popliteal angle/POP) shows an improvement in the Popliteal angle in both groups. Compared to Group 2, MFR considerably outperformed DOT in terms of post-treatment measures. According to the ANOVA (TABLE 2), time $F(101.109)$ had a major effect with a $df(1)$ p value of 0.000.

Group $F(5.200)$ had a main effect ($p=0.030, df(1)$).

Time group interaction $F(4.208), df(1), p=0.049$ was used to classify the major effects. Both groups significantly improved, according to Tukey's Post Hoc analysis. However, MFR ultimately outperformed DOT.

KNEE EXTENSION AROM

After receiving treatment for four weeks, both groups displayed improvement in knee extension AROM in high sitting positions, as shown in Figure 6

(Graph: AROM of knee extension). In the post-treatment assessments, Group 1 (MFR) improved significantly more than Group 2 (DOT).

According to ANOVA (TABLE 3) Time $F(76.326)$ had a main impact, with a $df(1)$ p -value of 0.000.

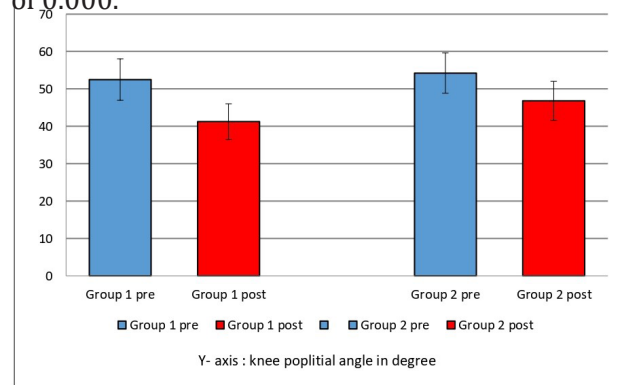


Fig. 5 : Graph Knee Popliteal angle/(POP)

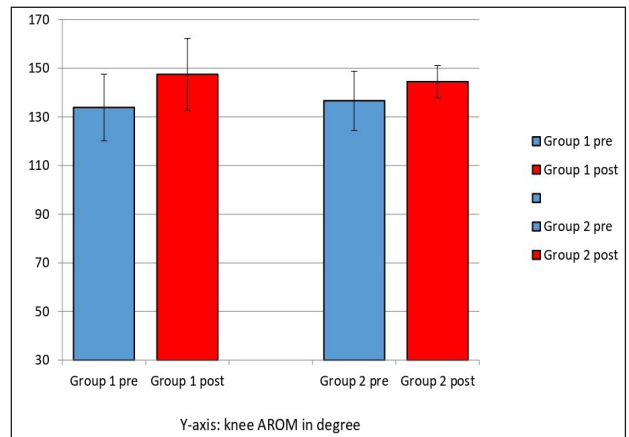


Fig. 6 : Graph AROM of knee extension

ANOVA (TABLE 2)						
FOR POPLITIAL ANGLE						
Test of between and within subject effect						
		SUM OF SQUARES	Df	MEAN SQUARE	F	SIGNIFICANCE
BETWEEN SUBJECT EFFECT	Group	213.891	1	213.891	5.200	0.030
	Error	1233.969	30	41.132		
WITHIN SUBJECT EFFECT	Time	1396.891	1	1396.891	101.109	.000
	Time X Group	58.141	1	58.141	4.208	.049
	Error	414.469	30	13.816		

ANOVA (TABLE 3)						
FOR KNEE ACTIVE RANGE OF MOTION						
Test of between and within subject effect						
		Sum of squares	Df	Mean square	F	Significance
Between subject effect	Group	0.250	1	0.250	0.001	0.976
	Error	8231.500	30	274.383		
Within subject effect	Time	1849.000	1	1849.000	76.326	0.000
	Time × Group	132.250	1	132.250	5.459	0.026
	Error	726.750	30	24.225		

Group F (0.001) did not have a main effect, $df(1) p= 0.976$.

Time group interaction F (5.459), $df(1)$, $p=0.026$ was used to classify the major effects. Turkey’s Post Hoc analysis demonstrated that each group had improved. However, the mean difference was not statistically significant at the end of the treatment.

DISCUSSION

PROM of knee extension was measured before recruitment for the study and after completion of 4 weeks of the intervention by Universal Goniometry with slow velocity. Both groups (Groups 1 and 2) experienced significant improvements in PROM of knee extension after the intervention. There was a considerable difference between the mean post-test values between the groups. This showed that Group 1 was more improved than another group. Group 1(MFR) demonstrated a difference of 17.81° (12.4%) from pre-test (143.38°) to post-test (161.19°) values, whereas Group 2(DOT) demonstrated a difference of 7.56° (5.2%) from pre-test (144.75°) to post-test (152.31°) values.

The PROM in Group 1 was improved more because of MFR. The probable mechanism for this could be that MFR improves tissue extensibility, blood flow, and lymphatic drainage and breaks adhesion. Another mechanism was the thixotropic property of fascia, which allowed softening of the soft tissue. This can be the result of the ground substance’s viscosity decreasing

during the application of myofascial soft tissue release. In support of my study result, [9] C.Kumar and S.N Vaidya (2014) showed the same effect of MFR on the hip joint’s calf, hamstring, and adductor muscles of 30 participants. He came to the conclusion that the neuro-reflexive change brought on by using forceful pressure on the musculoskeletal system while administering MFR could be the most likely mechanism for results. The hands-on method stimulates afferent receptors, which in turn trigger spinal cord and cortical central processing. Efferent inhibition typically follows afferent stimulation. This idea is implemented in the MFR technique when a stretch is applied, and the operator waits for efferent inhibition to occur so that relaxation takes place.

Salvi Shah et al. conducted a study in which they analysed some literature on myofascial release and came to the conclusion that it was a very successful, delicate, and secure hands-on technique for soft tissue mobilisation. By enhancing circulation and nerve system transmission, it boosted the body’s natural restoration abilities. The myofascial tissue was eventually able to extend and relax as a result of this low load sustained stretch, which led to an improvement in flexibility and range of motion [10].

Group 2 was taking DOT along with the same conventional exercise and result was also significant by increasing knee extension PROM.

This is supposed to be due to the vibration action produced by the DO device. When DOT was applied by using the handheld applicator, between the applicator and the tissue of the individual, an electrostatic field developed, this again created electrostatic attraction and friction; as a result penetrating vibration action was produced. This vibration action broke the excessive adhesion within the tissue. The penetrating effect was up to 8 cm depth in tissue level. So that the length of the hamstring muscle might be increased, resulting in improvement in knee extension PROM.

The study carried out by, ^[11] M.R.Hinmann(2013) et al. which was RCT on 15 athletes and non-athletes to estimate the effect of Ultrasound vs. Deep oscillation treatment on hamstring muscles. The length of the muscle was measured by passive SLR (Single Leg Raise) using an inclinometer. He concluded that both modalities significantly improved hamstring muscle length by both modalities but slightly more significant improvement gained in DOT than in Ultrasound. This study was also supporting my result.

Furthermore, the study supporting my result was done by, ^[12] Z.K. Winkelmann (2018) et.al was a randomized single cohort study on 29 physically active individuals who received DOT. The data (Passive SLR) was collected pre and post-time, and data were analyzed using a Pearson correlation and a dependent t-test. The result was found that there was a significant improvement in hamstring flexibility. This could be the possible reason that knee extension passive ROM might be increased.

From the analysis, it was found that between the two groups, the mean value after interventions were not similar. Both interventions had different effects after the completion of the duration of treatment, but comparatively, the MFR group demonstrated more improvement in mean value compared to the DOT group.

Popliteal angle was measured by goniometer in the child in supine lying posture and hip in 90° flexion and knee fully flexed starting Position. Then passively extend the knee with a fast speed (greater than the natural drop speed) and measure the angle where the knee joint got caught. After four weeks of intervention, both Groups 1 and 2

experienced a considerable decrease in POP angle. But the reduction of POP angle in Group 1 was much better than that of Group 2. Group 1(MFR) demonstrated a difference of 11.25°(21.4%) from pre-test (52.50°) to post-test (41.25°) values, whereas Group 2(DOT) demonstrated a difference of 7.44°(13.7%) from pre-test (54.25°) to post-test (46.81°) values.

POP angle was measured to know the rate of spasticity. POP angle was decreased; it means there was a reduction of spasticity of the hamstring muscle. Another way is if the flexibility or length of the hamstring muscle was increased, the POP angle was also reduced.

In Group 1, the probable mechanism for the result could be MFR was applied with slow velocity and firm pressure, which had a slow stretch effect on muscle and resulting firing of GTO (Golgi Tendon Organ) and lowered the tension in the spastic muscle, allowing the muscle's parallel elastic fibres (sarcomere) to lengthen. Therefore Hamstring spasticity might be reduced, and improvement of Popliteal angle.

Here supporting my study result, the study done by, ^[13] J.Paul(2018) et al. He did a study on 15 participants with diplegic CP who were intervened in MFR therapy on spastic hamstring muscle. The outcomes were measured by MAS and knee ROM by goniometry, which was analyzed through intra-group analysis. The result showed a significant reduction of spasticity and improvement of knee joint ROM.

In Group 2, DOT was applied, where vibration massage was produced between the applicator of the device and the subject tissue. Several studies showed vibration therapy significantly affected the reduction of spasticity. So vibration massage produced by the DO (Deep Oscillation) device helped decrease spasticity on hamstring muscle, resulting in reduced POP angle. The use of DOT as an intervention for minimizing spasticity in CP children is a somewhat unexplored field of study. To our knowledge, this study is the first to examine the impact of DOT on CP patients' spastic hamstring muscles.

Instrumental Vibration therapy had a better effect on the reduction of spasticity. The

mechanism is supposed to be vibration-stimulated by the skin receptors, proprioceptors, and muscle spindles via vibration transmission to the human body. We can infer that vibration stimuli detected by the brain cortex and processed by the central nervous system will have an impact on motor performance since proprioception is a crucial component of motor control. This presumption is in line with the findings of King and colleagues' (2009), who found that sound wave vibration therapy, improves motor symptoms and gait in Parkinson's disease patients.

Furthermore, a study by, ^[14]L.Ahlborg (2006), a prospective, randomized clinical trial on 14 children with diplegic spastic CP, intervened with either whole body vibration (WBV) or resistance training. The outcome spasticity and strength were measured by pre and post-data using MAS, muscle strength, six-minute walk test. He concluded that the group, who was taking WBV training, decreased knee extensor spasticity significantly. This study supports that vibration massage therapy helped in the reduction of spasticity.

The result of our study suggested that in each of the groups, knee extension AROM was improved significantly, but the difference between the two groups was not statistically significant. Group 1(MFR) demonstrated a difference of 13.63° (10.2%) from pre-test (133.81°) to post-test (147.44°) values, whereas Group 2(DOT) demonstrated a difference of 7.88° (5.7%) from pre-test (136.56°) and post-test (144.44°) values.

The mechanism of increased AROM in knee extension for both groups was overall the same. This was possibly due to the improvement of soft tissue extensibility of the hamstring muscle on the knee joint, which inhibits the abnormally increased tone of the hamstring. Once the abnormal tone of the hamstring muscle was reduced, the physiological restriction of active knee extension was reduced. Along with this, both the groups were taking conventional exercises, in which most of them were strengthening exercises of quadriceps muscle like half knee to standing, single leg standing, single leg bridging, and stepping (forward, sideway). Here child repetitively produced the active contraction of the

quadriceps muscle. Conventional exercises might also contribute to the improvement of the active range of motion. MFR or DOT to antagonistic (spastic hamstring) muscle along with conventional strengthening exercise to agonist (weak quadriceps) muscle might significantly improve AROM.

But the post-mean difference value between the two groups was not statistically significant. Here I was applying particular extra interventions (MFR/DOT), which were passive intervention techniques. I thought because of this; there might be not showing statistically significant. Otherwise, by increasing the sample size, the difference may be significant. For this, further study may be needed.

CONCLUSION

The findings of this study suggest that both Myofascial release and Deep Oscillation Therapy were effective interventions for increasing active range of motion, passive range of motion and reduce the tone of spastic hamstring muscle in spastic cerebral palsy; however, Poplital angle and PROM were improved more by Myofascial release therapy compared to DOT.

Clinical Implication

These can be easily incorporated into any rehabilitation technique (clinical or home-based setting). Early advice on strengthening exercise programs along with MFR/DOT can avoid the surgical intervention of spastic hamstring muscle in CP children.

Conflict of Interest: Nil

Source of Funding: Self

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