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"COMPARATIVE EFFECT OF STATIC STRETCHING AND ECCENTRIC TRAINING ON THE FLEXIBILITY OF CALF MUSCLE IN HEALTHY INDIVIDUALS"

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ABSTRACT

Background: The calf muscle complex is an important part of locomotor performance and weight loading. It has been found that due to straining the calf muscles, there is an increased risk of calf muscle injury and related foot symptoms. Since calf muscle plays a key role in the biomechanics of foot, tightness in the calf muscle can unevenly distribute the force of body weight load. Static stretching improves ROM, reduces stiffness and reduces the risk of injury from acute strain. Eccentric contraction is the movement of active muscles during contraction under load. Eccentric training has the effect of increasing flexibility for the lower body, helping to increase muscle length.

Aim: To Study the comparative Effect of Static stretching and Eccentric Training on the Flexibility of Calf Muscle in Healthy Individuals.

Method. 62 participants were selected based on the selection criteria. Participants were briefed about the nature of the study and the intervention. Their informed written consent was taken Prior and after the treatment the outcome measures, Knee to wall test were measured. Participants were randomly divided into two groups with n=31 in each group. Group A received static stretching while group B received Eccentric training. The treatment was given for 6 consecutive days.

Results: According to the finding, Eccentric training (Group B) showed significant difference in post mean value as compared to static stretching (group A). there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e., 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.

Conclusion: This study concluded that use of Eccentric training is more effective than Static stretching to reduce the calf muscle tightness in healthy individuals.

Key words: Knee to wall test, Static stretching, Eccentric training, calf muscle tightness.

INTRODUCTION

Flexibility is the ability of the joint or group of joints and muscle to effectively move through an unrestricted and pain free range of motion. Flexibility is the degree of extension that its tissue is capable of.[1]

Well-stretched muscles are more likely to achieve their full range of movement. This will improve performance. It also improves posture, relieves muscle tension and pain, and reduces the risk of injury. It usually tends to be inflexible as a result of inactivity. The less activity you have, the less flexibility you may have.

Strength and flexibility can reduce pain and disability, improve and maintain range of motion (ROM) and physical function of joints, and improve balance.

The calf complex is an important part of locomotion activity and weight bearing. The calf muscle is mainly composed of two muscles, the gastrocnemius muscle and the soleus muscle. The gastrocnemius muscle is the muscle of the back. Part of the lower leg. The soleus muscle is a flat muscle below the gastrocnemius muscle.[2]

Static stretches are very safe and effective stretches with a low risk of injury. Suitable not only for new-borns but also for people who tend to sit down. Static stretching is the active contraction of agonist muscles (i.e., active static) or the application of external forces such as gravity partner stretch aids (i.e., passive static). With stretch band. By placing the body in a position where the stretched muscles or groups of muscles are under specific tension.[3]

However, since the late 1990's up to early 2000's researchers have started discussing the potential harmful effect of static stretching on subsequent strength and power related activities.

But recent findings demonstrated that when include in a full warm up routine, short duration static stretching dose not impair subsequent strength and power performance.

In recent findings it is shown that when a warm up routine is into include with short duration static stretch it does not improve following stretching and performance.[4]

Eccentric (elongation) muscle contraction occurs when the force exerted on the muscle exceeds the momentary force generated by the muscle itself, forcing the muscle tendon system to elongate during the contraction. [5] When the force generated on the muscle is less than it really is, what is applied to the outside of the muscle is called eccentric contraction. [6] In direct comparison, eccentric myocardial movement can generate 2060% greater force. This is estimated to be 2060% higher than the concentricity level. [7] During this process, muscles absorb externally generated energy Stress explains why eccentricity is also called "negative work" rather than concentric (shortening) contraction or "positive work" [8]. Eccentric contractions are of interest in several areas for their specific physiological reasons and mechanical properties. Two characteristics of eccentric contraction are the requirements for maximum strength and low energy. This makes the contraction regime a good choice compared to traditional strength training.[9] Eccentric training is effective in increasing the flexibility of the lower body, helping to increase muscle length. Static stretching intervention

while dose improving flexibility may be due to changes due to elastic properties of the muscle.[10]

Age-induced structural and functional changes in many types of skeletal muscle, including humans.[11] Loss of muscle mass and strength is associated with age and sex differences. The results showed that the mean difference in gastric pain and muscle tone between 2039-year-old men and women was significant with the mean difference being $P < 0.01$. Some risk factors for many lower extremity disorders are calf muscle strain and limited back muscle range of motion, particularly Achilles tendonitis.[12]

Therefore, if you find it beneficial to increase ankle mobility a bit, then stretching the calf muscles is the way to go. Regular use of high heels has been shown to cause discomfort to the calf muscles. Studies have shown that when you start wearing flats, you also notice muscle discomfort.[13] High heels are a major cause of foot problems and lower extremity pain, associated with chronic conditions such as varicose veins, calves, calluses, ankle pain, Achilles tendon strains, and balance inflammation. and Haglund deformation.[14]

AIM AND OBJECTIVES

AIM:

To Study the comparative Effect of Static stretching and Eccentric Training on the Flexibility of Calf Muscle in Healthy Individuals

OBJECTIVES:

1. To find out the effect of Static Stretching on the calf muscle flexibility.

2. To find out the effect of Eccentric Training on the calf muscle flexibility.

3. To compare the effectiveness of Static Stretching and Eccentric Training in improving calf muscle flexibility.

MATERIAL AND METHODOLOGY

The Comparative study was conducted at the Physiotherapy OPD, WH, MMC, Miraj. The study was approved by the Institutional Ethical research committee of Miraj Medical Centre, college of physiotherapy, Wanless Hospital, Miraj.

Subject who completed the inclusion and exclusion criteria were included in the study. The inclusion criteria Age group between 18 to 39 years old Healthy male and female both were included. The exclusion criteria were subjects with recent injury in and around ankle joint, history of acute/chronic pain in the lower limb. written informed consent was obtained from all the subjects. 62 participants were selected based on the selection criteria. Prior and after the treatment the outcome measures, Knee to wall test were measured. Participants were randomly divided into two groups with n=31 in each group. Group A received static stretching while group B received Eccentric training. The treatment was given for 6 consecutive days.

GROUP A: STATIC STRETCHING FOR CALF MUSCLE

Position: A subject was made to Sit with the involved leg straight out in front of you. Place a towel around the foot and gently pull toward you, till the f a stretch was felt in the calf muscle. In this, the ankle is dorsiflexed and soft tissues were lengthened just past the point of tissue resistance and then hold the lengthened position for 30 seconds, and then it was slowly released. This cycle was repeated 3 times in 1set and each session included 3 sets. The single session lasted for 20 minutes including 5 minutes each of warm-up and cool-down exercises and a rest period of 1 minute in between every cycle of static stretching.

Gastrocnemius Stretch

Soleus Stretch

GROUP B: ECCENTRIC TRAINING FOR CALF MUSCLE

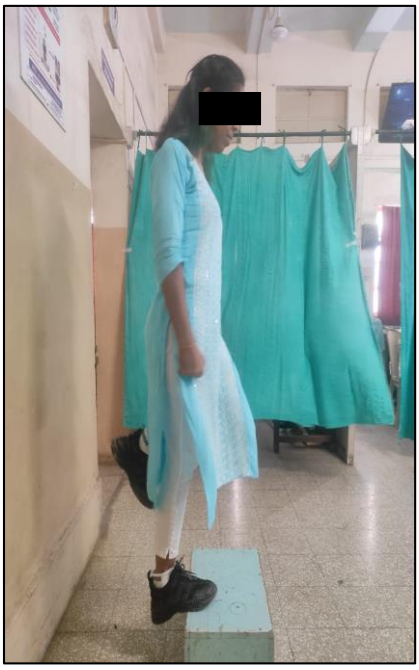
1. In this, each position was held for 3 seconds and 15 repetitions in each session. And there are 3 sets in 1 session.
2. Single session lasted for 25 minutes, including 5 minutes of warm-up and cool-down exercise Before and after session.
3. Rest period given was of 1 minute in every cycle of eccentric training.

Procedure:

1. Stand on step on the balls of your feet and keep your heels over the edge and your knees straight.
2. Lift your good leg off the ground.
3. Lower your painful heel down Below the step edge.
4. Put your good side onto the step and use it to lift your painful side back to the heel starting Position then go back to the start.

(1)

(2)



(3) **(4)**

RESULT

Data analysis was performed using Statistical Package for the Social Sciences [SPSS] software. The level of significance for PRE and POST test for passive knee extension test between group was calculated using Mann Whitney test.
The level of significance for within group was done using Wilcoxon test.

For this study, 62 participants with calf muscle tightness were included. To check the Flexibility, Knee to wall test were used respectively for both the groups, pre and post the intervention.

Normality test using Kolmogorov-Smirnova

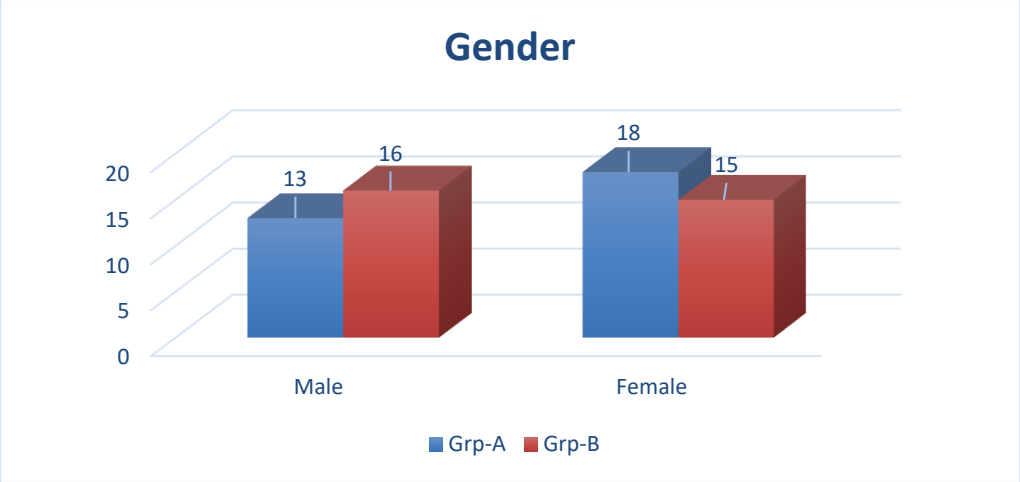
Group	Time frame	KNEE TO WALL TEST	
		z-value	p-value
Group A	Pre	0.093	0.200
	Post	0.111	0.200
	Difference	0.149	0.050
Group B	Pre	0.129	0.200
	Post	0.147	0.052
	Difference	0.127	0.200

Data set for group A is normally distributed as the variables have indicated non-significant outcome in the observation. The researcher shall use parametric test for data analysis purpose in the following sections for Group A.

Data set for group B is normally distributed as the variables have indicated non-significant outcome in the observation. The researcher shall use parametric test for data analysis purpose in the following sections for Group B

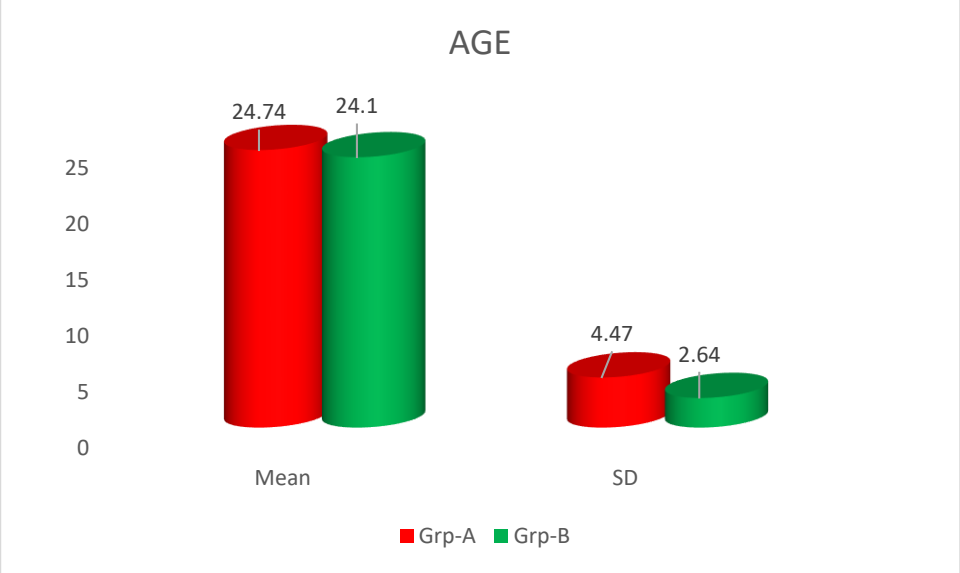
Gender & Group Cross tabulation

Particular		Group		Total	p-value
		Grp-A	Grp-B		
Gender	Male	13	16	29	0.445
	Female	18	15	33	
Total		31	31	62	



Group Statistics

Particular	GROUP	Mean	SD	p-value
AGE	Grp-A	24.74	4.47	0.492
	Grp-B	24.10	2.64	



Within group Pre and post paired sample t test for Group A

Variable	Pre		Post		Diff		Effect size	t – value	p – value
	Mean	SD	Mean	SD	Mean	SD			
KNEE TO WALL TEST	4.68	1.61	5.69	1.62	1.01	0.29	3.42	19.039	0.001*

* Significant at 5% level

From the above within groups' analysis using paired sample t test, it is observed that KNEE TO WALL TEST mean value indicated changes post treatment and higher mean values are recorded for post treatment outcome and also the standard deviation shows the limited consistency with post treatment value which is more than pre value.

The effect size Cohen's D indicates 3.42 value which is assumed to be very high in effect size as per the standard parameters of reference.

Thus, reference to the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e., 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention

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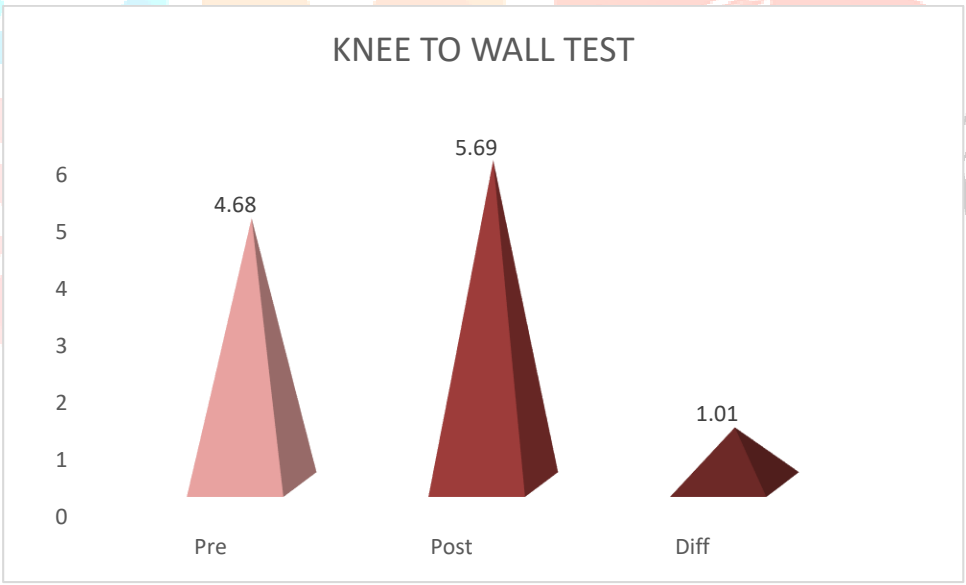


Variable	Pre		Post		Diff		Effect size	t – value	p – value
	Mean	SD	Mean	SD	Mean	SD			
KNEE TO WALL TEST	5.02	1.99	11.91	1.47	6.89	1.08	6.38	35.49	0.001*

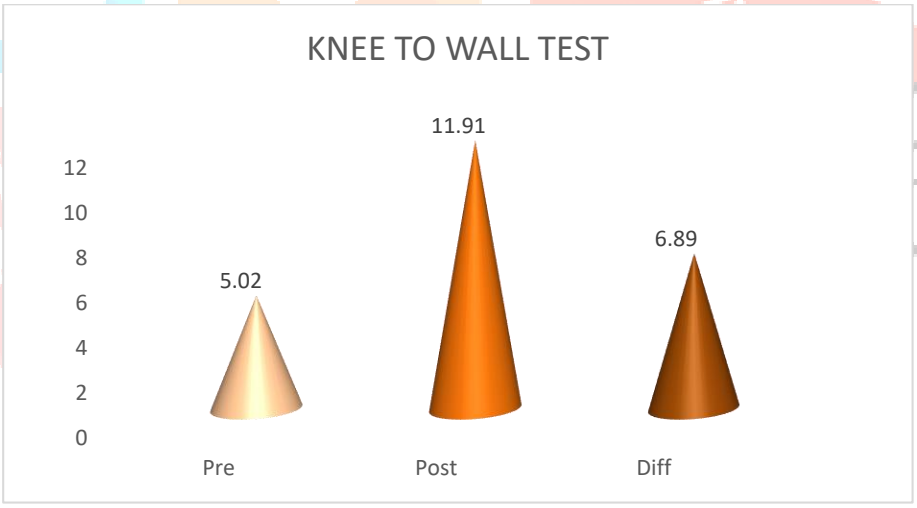
Within group Pre and post paired sample t test for Group B

* Significant at 5% level

. From the above within groups' analysis using paired sample t test, it is observed that KNEE TO WALL TEST mean value indicated changes post treatment and higher mean values are recorded for post treatment outcome and also the standard deviation shows the limited consistency with post treatment value which is more than pre value.

The effect size Cohen's D indicates 6.38 value which is assumed to be very high in effect size as per the standard parameters of reference.

Thus, reference to the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.



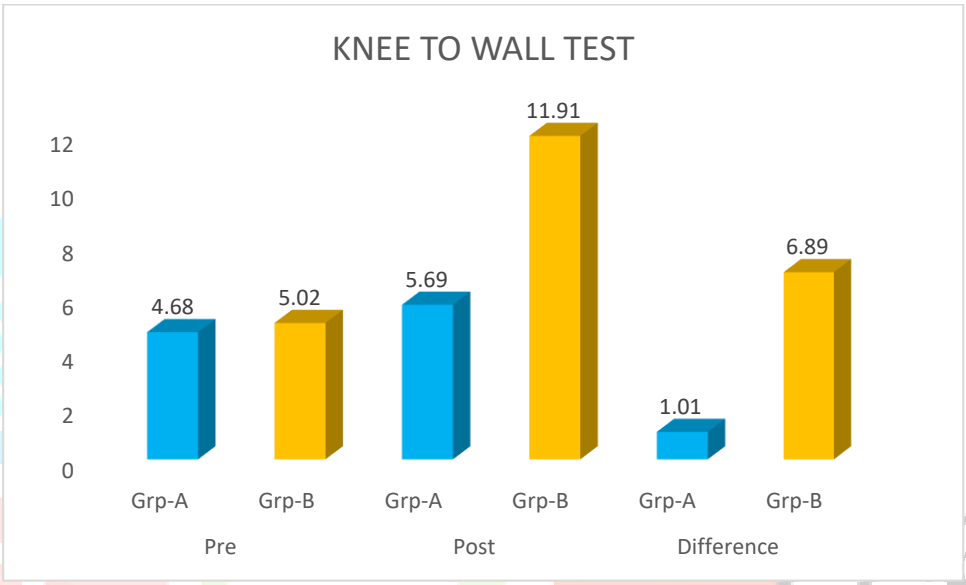
Between groups analysis using independent sample t test

Variable	Time frame	GROUP	Mean	SD	t-value	p-value
KNEE TO WALL TEST	Pre	Grp-A	4.68	1.61	0.730	0.468
		Grp-B	5.02	1.99		
	Post	Grp-A	5.69	1.62	15.809	0.001*
		Grp-B	11.91	1.47		
	Difference	Grp-A	1.01	0.29	29.248	0.001*
		Grp-B	6.89	1.08		

From the above table it is observed that between groups analysis is not significant across the pre time frame at 5% level significance but it is significant for post and difference values at 5% level significance since p-value is less than 5% level (i.e. 0.001 < 0.05)

Thus it is inferred that there is a substantial statistical significant difference between the groups across post and difference values.

Further from the post and difference mean values; it is observed that group B is better as higher mean is recorded as compared to group A after the medical intervention.



Comparative analysis between groups using effect size outcome

Variable	Group A Effect size	Group B Effect size	Remarks
PEAK FLOW METER	3.42	6.38	Group B is better

Note: Higher the effect size outcome is better recovery or health improvement post intervention

Results from analysis

The final analysis proves that both the groups were clinically significant but the statistical analysis was not analytically significant.

The mean value Static stretching and Eccentric training indicated changes post treatment and higher values are recorded for post treatment outcome and also the standard deviation shows the limited consistency with post treatment value which is more than the pre value.

Based on the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e., 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.

Thus, it is inferred that there is a substantial statistically significant difference between the groups across post and difference values.

Further from the post and difference mean values; it is observed that group B is better as higher mean is recorded as compared to group A after the medical intervention.

DISCUSSION:

The present study was done to compare the effectiveness of static stretching and eccentric training in healthy individuals with muscle tightness. It is more common clinical feature of Achilles tendinitis. But now a days it is commonly seen in healthy individuals with wrong standing posture or use of imperfect footwear for longer period of time. Saima Jabbar et.al. (2020) concluded that 77.5% of the population complaint of forefoot pain due to the regular wearing of high heels shoes.[31] It is also affects the ankle range of motion like ankle dorsiflexion and plantarflexion.

In this study 73 subjects were screened for calf muscle tightness. Out of which 62 subjects met the inclusion and exclusion criteria. Further these subjects were randomly allocated in Group A (Static stretching) and Group B (Eccentric training) both the group were given intervention for 6 days over a period of one week. In group A (Static stretching) active stretching was done by the subjects with the help of towel. The position was long sitting position. Here subjects actively performed stretch on the calf muscle with help of the towel and then held the lengthened position for 30 seconds and then released. This cycle was repeated for 3 times in 1 set and each session include 3 sets. And in Group B (Eccentric training) subjects held each position for 3 seconds and 15 repetitions in each session and there were 3 sets in 1 session.

Stretching exercises are traditionally part of an exercise and recovery program. Static Stretching is a type of stretching exercise that stretches muscles weakly and takes a long time (usually 30 seconds). Stretching on the muscles improves ROM, reduces muscle stiffness, and reduces the risk of injury from acute muscle tension.

Eccentric contraction is the movement of active muscles while stretching under load. Eccentric training is a repetitive eccentric contraction. Eccentric contraction is one of the distinct steps in muscle and tendon movement. These include isometric contractions (no movement), isotonic contractions, and concentric contractions (shortening). In muscle, there are "stress-generating tissues composed of small contractile units called sarcomere" and "thick (myosin) and thin (actin) muscle filaments (muscle filaments or proteins) overlap and cross-bridge bond (attachment) to each Form a shape.

MC Nair et al. conclude that stiffness was significantly reduced during cycling than during static stretching within a single stretch session, with more mobile components of soft tissue such as polysaccharides and water in the collagen scaffold during cycling. There are some studies that speculate that it will be redistributed more quickly.[32]

Hence the present study concludes that eccentric training showed more flexibility improvement in calf muscle than static stretching while conducting the study we learned some of the common aetiology of calf muscle tightness in healthy population. The major benefit of the treatment seeing as the treatment can be performed by the individuals themselves, according to their need. This treatment protocol is beneficial for individuals in their daily hectic life routine with helping them in reducing the tightness and improving the flexibility of calf muscle, as it is easier and in everyone’s budget.

CONCLUSION

This study concludes that the use of Eccentric traning is more effective than static stretching to reduce calf muscle tightness in healthy individuals.

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