Comparison of Intermittent Occlusion and Static Stretching in the Prevention of Muscle Soreness in Young Adults

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ABSTRACT

Objective: To compare the effectiveness of intermittent occlusion and static stretching of lower limb muscle groups in the prevention of exercise-induced muscle soreness in young adults.

Methods: A randomized controlled trial using a non-probability, convenient sampling technique was conducted to determine the effectiveness of intermittent occlusion and static stretching. A total of 22 young adults (aged 18–25 years) without comorbidities were included, with 11 participants in each control and interventional group. Data were collected from Shalimar Club, Rawalpindi, and analyzed using SPSS version 21. Exclusion criteria included comorbidities assessed using the PAR-Q questionnaire. The study was completed in 8 months. Muscle soreness was measured pre- and post-intervention.

Results: The interventional group consisted of 63.6% females and 36.4% males, while the control group had 54.5% females and 45.5% males. Both groups included individuals who had not engaged in excessive physical activity in the last six months. Pain, measured using the Numeric Pain Rating Scale, was reduced with a mean score of 0.45 in the interventional group and 0.81 in the control group. Functional outcomes such as ankle dorsiflexion (mean: 14.86 vs. 12.36), plantar flexion (mean: 54.01 vs. 55.04), and leg circumference (mean: 11.09 vs. 16.681) showed improvement in both groups, with intermittent occlusion showing slightly better results in some measures.

Conclusion: Intermittent occlusion and static stretching were both effective in reducing exercise-induced muscle soreness. While no significant vital changes were observed, static stretching demonstrated slightly better outcomes in terms of pain reduction and functional improvements compared to intermittent occlusion.

Keywords: Muscle Soreness, Intermittent Occlusion, Static Stretching, Young Adults, Vital Signs, Pain Reduction, Blood Pressure.

INTRODUCTION

Muscle soreness, which is also known as post-exercise muscle soreness and delayed onset muscle soreness (DOMS), is a common physiological scar that is incurred with vigorous or unfamiliar physical activities (Sonkodi, 2022). Delayed onset muscle soreness (DOMS) is a multi-factorial condition that is characterized by muscle pain, stiffness, swelling, impaired range of motion, acute tissue injury, reduced strength and power(Camacho-Villa, Reina-Torres, Herrera-Villabona, &

Delgado-Díaz, 2021). It usually appears 8-12 hours after activity, reaches its maximum after 24 to 72 hours and resolves within 7 to 10 days. Muscle soreness caused by exercise can also be sub classified into acute soreness which develops during or immediately following exercise and delayed soreness which develops several hours following the activity(Hotfiel et al., 2018; Lewis, Ruby, & Bush-Joseph, 2012). Even though, DOMS has been the subject of thorough research, there is no magic shot in the form of an intervention which will ensure its consistent prevention or treatment.

The main cause of DOMS is muscle soreness after an intense exertion as a consequence of endpoint sarcomere damage and an associated inflammatory process(Cheung, Hume, & Maxwell, 2003). Pains can be treated with painkillers, especially non-steroidal anti-inflammatory drugs (NSAIDs), but common side effects such as stomach pain led to the search for other ways of alleviating the pain that do not require the use of pharmaceuticals. These include, but are not limited to, massage, ice therapy, weight training, hyperbaric oxygen treatment, and different types of stretching all reported to be used to relieve pain and speed recovery to varying degrees of success.(Nahon, Lopes, & de Magalhães Neto, 2021)

One of the novel ones that have caught their interest is vascular occlusion, which has shown promise in recent studies in reducing muscle soreness that persists after physical activity. (Bryk et al., 2016)This method involves reducing blood flow while exercising or afterward and has been reported to help reduce muscle injuries and promote faster recovery in active individuals. There are reports of vascular occlusion which also suggest positive effects on CK activity and reduced AEP in some members during exercising(Ferraz et al., 2018). However, there is still a gap in literature concerning occlusion pressure and its effects on important parameters such as blood pressure and blood oxygen levels raising the need for more research.

Another measure used most commonly is static stretching which is quite popular and also one of the oldest methods used to prevent DOMS. In this case, it requires the muscle group being stretched to be held in a stretched position for 15–20 seconds in order to improve flexibility, elasticity of the muscle and relieve soreness(Assumpcao et al., 2017; Harahap & Siregar, 2021). Stretching has also proven to be beneficial in improving the quality and physical functionality of a person, although its position in the hierarchy of interventions that can prevent DOMS, such as intermittent occlusion, is rather vague.04:05 PM

Even after improving the comprehension of DOMS and its treatment, the literature lacks studies that confront the influence of intermittent occlusion with static stretching especially when it concerns primary measurement outcomes such as heart rate, blood pressure, respiratory rate and oxygen saturation levels. The relevance of studying the role of these two interventions in the prevention of DOMS is necessary for formulating evidence-based recommendations for recovery so as to minimize discomfort during training.

This study is intended to fill these gaps by assessing the effects of intermittent occlusion and static stretching on muscle soreness. If the safety and effectiveness of these interventions are explored, the results may be beneficial to fitness lovers, athletes and health practitioners in developing effective preventive strategies for DOMS.

METHODOLOGY

This research was a randomized Control trial comparing intermittent occlusion and static stretching for the prevention of muscle soreness in young adults. The sample size of 22 was calculated by OpenEpi and including the participants selected by non-probability convenient sampling and randomized by lottery method in intervention and control groups.

This study was carried out for 6 months in places such as Shalimar Club, Shapes gym male, and female persons aged 18–25 years who are going to start fitness programs. Absolute inclusion criteria consist in absence of any previous exercise-induced muscle pain for at least six months, cardiovascular diseases, skeletal lesions, uncontrolled hypertension and obesity (BMI ≥30 kg/m²). The Physical Activity Readiness Questionnaire (PAR-Q) was used to assess participants' readiness to engage in physical exertion.

The data collection consisted of: 1) Baseline measurements of a leg circumference measurement using the measuring tape, a measurement of the range of motion (ROM)(Milanese et al., 2014) by the goniometer, a pain intensity measurement using the Numerical Pain Rating Scale (NPRS) (Firdous, Mehta, Fernandez, Behm, & Davis, 2017) and a Borg CR-10 scale measuring subjective exertion of the pain prior to the intervention. Both intervention and control groups participated in a standard warm-up protocol by heel raise with 2 kg dumbbells until reaching a perceived exertion (Borg scale) of 4(Andrade, Zamunér, Forti, França, & Silva, 2017).

After the warm-up, Group A was given intermittent occlusion for 12 minutes while laying supine with proximal thigh cuffs applied at a pressure of 220 mmHg. Pain was periodically monitored to make sure the group's level of discomfort doesn't surpass 6 on the NPRS. Group B, on the other hand, targeted the calf muscles with static stretching for ten minutes. All parameters had their post-intervention measures redone both right away and three days later.

SPSS version 21 was used for data analysis, and suitable statistical tests were used to assess changes in leg circumference, ROM and pain levels between the groups. This approach was intended to yield solid and trustworthy findings when assessing the efficacy of static stretching and intermittent occlusion in preventing muscular soreness.

RESULTS

The study evaluated the effectiveness of intermittent occlusion and static stretching in improving ankle range of motion (dorsiflexion and plantar-flexion), reducing leg circumference, and alleviating pain (NPRS). Significant differences were observed in several outcomes between the two groups.

Participants were assigned on accordance to exclusion and inclusion criteria. There were total of 22 participants which were divided into Intervention and Control groups. There was 3 drop outs after the initial examination by using the Par-q Questionnaire.

Demographic baseline values of all Variables of the both groups were compare on basis of mean± std. deviation in Table 6.1. This table showed the summary of comparison of demographics like ‘age’ and ‘gender’ of all participants across both groups.
The mean age of participants in the Group A (Intermittent Occlusion) was 21.81±2.6388 years while in Group B (Static Stretching) was 22.27±2.611 years.

Fig 6.1 and Fig 6.2 showing Pie chart for close data showing the distribution of male and female members in both the groups. Which shows group A includes 63.6% of females in this study were aged ranging from 18 to 25 and remaining 36.4 % were males, and group B had 45.5% of males and 54.5% of females.

Shapiro Wilk test for normality was used to assess the normality of data. The results should that data was normally distributed. And Independent t test was used to assess difference between both the groups.

For ankle dorsiflexion, the intermittent occlusion group demonstrated a significant improvement in the right leg post-test (14.85 ± 3.05) compared to the static stretching group (12.23 ± 2.60) with a p-value of 0.042. However, for the left leg, while a notable trend was observed (14.86 ± 3.08 vs. 12.36 ± 2.54), the difference did not reach statistical significance (p-value = 0.051). In terms of ankle plantar-flexion, neither group exhibited significant differences post-test for both the right leg (54.10 ± 9.31 vs. 55.27 ± 3.19, p-value = 0.792) and the left leg (54.01 ± 9.31 vs. 55.04 ± 3.28, p-value = 0.767). (Table No 2)

For leg circumference, the intermittent occlusion group showed a substantial reduction in both the right and left legs compared to the static stretching group. Pre-test measurements for the right leg were 12.15 ± 1.87 in the occlusion group versus 16.81 ± 2.64 in the stretching group (p-value = 0.000), and post-test values were similarly significant (11.09 ± 2.07 vs. 16.68 ± 2.80, p-value = 0.000). The left leg followed the same pattern, with significant differences both pre-test (12.15 ± 1.87 vs. 16.73 ± 2.80, p-value = 0.000) and post-test (11.09 ± 2.07 vs. 16.68 ± 2.80, p-value = 0.000).

Pain levels, measured via the NPRS, showed improvements in both groups, but the difference was not statistically significant. The intermittent occlusion group reported slightly lower post-test pain (0.45 ± 0.52) compared to the static stretching group (0.81 ± 0.75), but the p-value was 0.244. Pre-test NPRS scores were also not significantly different between groups (7.18 ± 1.25 vs. 5.54 ± 1.29, p-value = 0.325). (Table No 3)

Table No 1: Demographic data of both groups

Study group	Variables	N	Mean± SD
Intermittent Occlusion	**Age**	11	21.81±2.638
	Gender	7 Females 4 Males	63.6% 36.4%
Static Stretching	**Age**	11	22.27±2.611
	Gender	6 Females 5 Males	54.5% 45.5%

Table No 2: Between Group Analysis of Ankle ROM

Outcome Variable	Intermittent Occlusion Group	Static Stretching Group	P-value
Ankle Dorsiflexion Right Leg (Pre-test)	12.8182±3.45885	12.4818±2.24580	.790
Ankle Dorsiflexion Right Leg (Post-test)	14.8545±3.05200	12.2273±2.60157	.042
Ankle Dorsiflexion Left Leg (Pre-test)	12.8182±3.45885	12.6000±2.23652	.852
Ankle Dorsiflexion Left Leg (Post-test)	14.8636±3.08294	12.3636±2.54058	.051
Ankle Planter-flexion Right Leg (Pre-test)	52.0273±8.97576	57.3000±3.00699	.138
Ankle Planter-flexion Right Leg (Post-test)	54.1091±9.31294	55.2727±3.19659	.792
Ankle Planter-flexion Left Leg (Pre-test)	52.0091±8.97780	57.0909±2.87939	.156
Ankle Planter-flexion Left Leg (Post-test)	54.0182±9.30826	55.0455±3.28979	.767

Table No 3: Between Group Analysis of Leg Circumference and NPRS

Outcome Variable	Intermittent Occlusion Group	Static Stretching Group	P-value
Leg Circumference Right Leg (Pre-test)	12.1545±1.87156	16.8182±2.63887	.000
Leg Circumference Right Leg(Post-test)	11.0909±2.07145	16.6818±2.79529	.000
Leg Circumference Left Leg (Pre-test)	12.1545±1.87156	16.7273±2.79610	.000
Leg Circumference Left Leg (Post-test)	11.0909±2.07145	16.6818±2.79529	.000
NPRS (Pre-test)	7.1816±1.25045	5.5364±1.28629	.325
NPRS (Post-test)	.4545± .52223	.8182±.75076	.244

DISCUSSION

This study's findings indicate that both intermittent occlusion and static stretching are effective interventions to reduce muscle soreness due to physical activity. Nonetheless, intermittent occlusion was more effective in decreasing soreness and shortening recovery time. The findings are consistent with literature, but further, the study fills gaps in understanding of the effects of intermittent occlusion on physiologic parameters of importance and its effectiveness compared to static stretching.

Intermittent occlusion improved ankle dorsiflexion, significantly in the right leg (p = 0.042), and reduced leg circumference and Numeric Pain Rating Scale (NPRS) scores following the intervention. These findings are consistent with those of Neto et al., which found that blood flow restriction in conjunction with low-intensity resistance training decreased delayed onset muscle soreness (DOMS) and improved recovery. Neto used both continuous and intermittent blood flow restriction, and his findings underlined the efficacy of intermittent occlusion as a recovery measure with minimal negative side effects(Neto et al., 2017).

Additionally, the noted safety of intermittent occlusion, which kept the vital signs within normal ranges, is consistent with studies such as the one by W. Page and R. Swan (2017). A study by their group, in which they reported the use of lower-limb intermittent occlusion, also shows a reduction of muscle damage and soreness without significant variation of vital parameters. These results confirm these studies and demonstrate that intermittent occlusion at a pressure of 220 mmHg is safe while representing the therapeutic benefit(Page, Swan, Patterson, & sport, 2017).

Static stretching, a traditional method for addressing muscle soreness, also received benefits in terms of pain and improved muscle flexibility. These results are in agreement with those of Xie et al. (2018), who revealed that static stretching does reduce DOMS when utilized post-exercise. In our study, however, in terms of pain relief and recovery time (NPRS and circumferences), the outcomes after intermittent occlusion were slightly better than static stretching, which can be seen clearly by noting the mean differences(Xie et al., 2018).

The most interesting result in terms of specificity was the lack of significant effect of intermittent occlusion on ankle plantar-flexion, suggesting that muscle group specificity may limit the magnitude of this training method. This result is in agreement with previous work done by Hughes et al. (2017), which suggested that blood flow restriction might not always improve every aspect of muscular performance, although it does seem to help with reductions in soreness and recovery for localized areas.(Hughes, Paton, Rosenblatt, Gissane, & Patterson, 2017)

Our findings emphasize that intermittent occlusion expedites recovery at minimal cost in terms of pain. Pain during occlusion was carefully assessed using NPRS, and interventions were suspended if NPRS scores were higher than 6. Moreover, we used it as a way to keep our participants safe, as it suggested that intermittent occlusion could be incorporated into both clinical and athletic environments.

In conclusion, we have, however, to acknowledge the limitations of our study despite these promising findings. Limitations include, first, that the sample size is statistically adequate but may not capture variations across varied populations. Second, the study did not measure long-term effects of repeated use of these interventions. Long-term effects of intermittent occlusion on muscle recovery and performance could also be followed in future studies.

Comparison with Other Studies There have been several studies looking at various methods of reducing DOMS, and our findings correlate with many of those studies. In a systematic review, Van Hooren and Peake (2018) highlighted that, although the evidence is limited, there seems to be some promise for the use of blood flow restriction when it comes to reducing the muscle soreness brought on by exercise (particularly when blood flow restriction is used in combination with low-intensity exercise interventions)(Van Hooren & Peake, 2018). Similarly, R. Takada et al. (2012) exhibited that vascular occlusion might successfully lower both creatine kinase values and muscle soreness, as noted in our results, which presented a lower NPRS for the intermittent occlusion group(Wong, Chaouachi, Dellal, & Smith, 2012).

In opposition, Herbert et al. (2011) suggested that stretching techniques may not be adequate means for DOMS prevention(Herbert, de Noronha, & Kamper, 2011). Although our results demonstrated the effectiveness of static stretching alone, the more favorable results with intermittent occlusion indicate that stretching alone might not be adequate for individuals with significant muscle soreness.

CONCLUSION

Intermittent occlusion is a safe and effective means of reducing muscle soreness and accelerating recovery without compromising vital parameters. Although static stretching is still a capable option for optimizing range of motion, again, intermittent occlusion proved to be superior in certain outcomes—specifically in factors related to pain and recovery. This substantiates intermittent occlusion as an effective but novel treatment option in the management of DOMS.

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