

Comparing the Effectiveness of Cryotherapy and Infrared Radiation with Stretching in Prevention of Delayed Onset Muscle Soreness

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Abstract: *This study aims to compare the effectiveness of cryotherapy and stretching versus infrared radiation and stretching in prevention of exercise induced delayed onset muscle soreness. The study involved 30 healthy female individuals divided into three groups: Group A cryotherapy with stretching, Group B IIR with stretching, and Group C Control group. The results showed that both treatments were effective, but thermotherapy and stretching showed a better increment in preventing exercise - induced delayed onset muscle soreness.*

Keywords: Delayed Onset Muscle Soreness, Cryotherapy, Infrared Radiation, Stretching, Physiotherapy

1. Introduction

Delayed onset muscle soreness (DOMS) is the perception of pain and discomfort in muscles following an exercise regime that involves increased intensity, longer duration, unfamiliar movements, or eccentric muscular work. It is commonly experienced by anyone who has undergone unaccustomed exercises and suffered from exercise-induced muscle damage (EIMD). [1] It is typically experienced by all individuals regardless of their fitness level and is a normal physiological response to increased exertion and introduction of unfamiliar physical activities. [2] DOMS, which occurs 48-72 h after activity, is more common following eccentric contraction due to the significantly greater force produced. [3-5] In addition to pain, DOMS is associated with loss of strength, loss of motion, and swelling of the involved musculature. [1, 3]

According to Clarkson and Sayers, [6] immediately after exercise, there is up to 60% loss in muscle strength that could persist for 10 days. The pain and discomfort associated with DOMS generally peaks 24-48 h following the activity and resolves itself within 3-7 days without any special treatment. [2, 7]

In some studies, muscle damage due to eccentric exercise is associated with reduced muscle performance. [9] Manifestations of DOMS are muscle damage including pain, spasm, decreased range of motion and functional strength as well as biochemical signs such as increasing creatine kinase (CK) and lactate dehydrogenase (LDH) enzymes [10]; some studies have indicated that after eccentric exercise, omega-3 supplementation is a decreasing marker of soreness. [11] The presence of muscle enzymes in the blood after intense exercise indicates some structural damage in the muscle cell membrane and the increase rate is 2 - 10 times their normal amount. Some sources have stated that Z lines are torn due to increased stress or pulling muscle fibers in eccentric contraction of the muscle. [12, 13] Localized anemia leads to accumulation of an unknown pain substance that causes

stimulation of nerve terminals, associated with muscle pain. Muscle pain causes reflective seizure that can lead to localized anemia. [14] Finding ways to reduce the incidence and severity of muscle pain is one of the important aspects of sports and health sciences. [8] Anti-inflammatory drugs, antioxidants, ultrasound, massage, stretching exercises, cryotherapy methods have been tested to reduce DOMS, while another method was vibration training before eccentric exercise. In some cases, a combination of one or more of these described methods was adapted by researchers but due to their lack of reliability and validity, there is no consensus among researchers. [8]

Infrared radiation has been shown to be effective in the treatment of muscle or joint pain including muscle spasm and stiffness. It has been reported to speed up the healing process in musculoskeletal injuries by increasing microcirculation through the release of nitrous oxide from hemoglobin. [15] However, its efficacy as a treatment modality in the management of symptoms associated with DOMS has not been thoroughly investigated; the few studies in this area have given conflicting results on the efficacy. Glasgow *et al.*, (2001) [16] for instance, reported on the results of a randomized controlled clinical trial of low-level infrared therapy in 24 subjects with experimentally induced muscle soreness and found no significant differences between the treatment and placebo groups. In the study, infrared radiation (IRR) was administered for consecutive 5 days following the inducement of DOMS.

Though the effect of DOMS is associated with only temporary morbidity as a result of pain, soreness, and reduced muscular performance, it affects the overall performance of the person who is affected. It also increases the risk of injury, [17] This study aims to evaluate the comparative Effectiveness of thermotherapy and stretching v/s infrared radiation and stretching in prevention of delayed onset muscle soreness.

2. Methodology

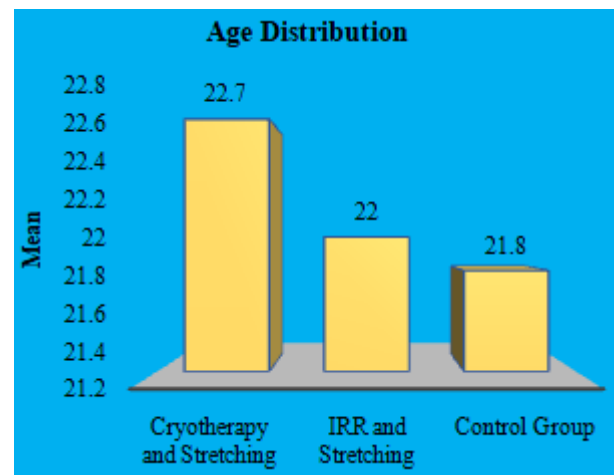
An experimental study was carried out on 30 female subjects by random sampling with the age group of 18 - 23 years. Subjects who recently underwent surgery, subject having infection of skin disease, bruises, infection or injuries at the site, recent fracture or sprains and Subjects with regular exercise, musculoskeletal and neurological disorders, cardio - respiratory condition, non - willing population, athletes and semi - professional /daily sports players were excluded from this study.

3. Procedure

Samples were collected by random sampling method. Total 30 subjects (n - 30) between the age group of 18 - 23 years participated in the study. The details of the treatment were explained to the subjects and written consent was taken. Simple random sampling via chit system was done and subjects were divided into 3 groups i. e., group A cryotherapy and stretching (n - 10), group B i. e., IIR and stretching (n - 10) and group C was control group (n - 10). As a pre - test measurement, the subject was ask to rate their pre exercise level of pain using NPRS measurement were taken. The non dominant limb of each subject was selected for testing purpose. Subject was fully instructed about DOMS and was made to perform bilateral eccentric work consisting of 5 x 10 set of squats exercise resulting in DOMS in quadriceps muscle. Group A was treated with cryotherapy and stretching (five static stretching with 30 second hold both before and after exercise. Then Ice packs were applied for 20 minutes) Group B was treated with IIR and stretching (five static stretching with 30 second hold both before and after exercise then, IIR was given for 20 minutes) and group C subject did not receive any treatment.

All the above treatment were given in 3 session for 20 minutes each - First after the exercise, after 12 hours and then after 24 hours. Pain intensity using NPRS were measured after 24, 36 and 48 hours following exercise protocol.

4. Result

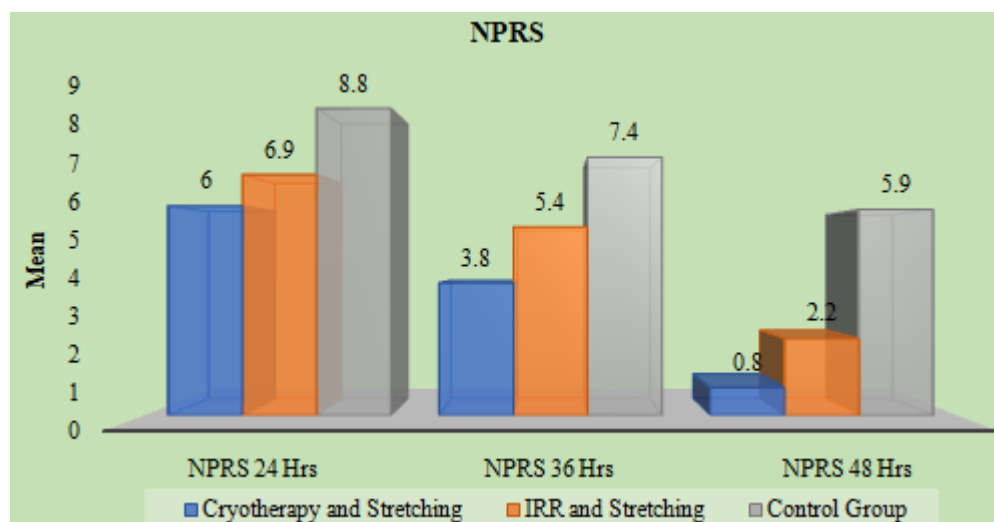


Graph 1: Represents descriptive statistics of age for total 30 participants (i. e., Group A: 10 subjects, Group B: 10 subjects and Group C: 10 Subjects)

The mean age of female count receiving cryotherapy and stretching was 22.7, IRR and stretching was 22 and control group was 21.8. (Refer graph 1).

Table 1: Shows mean and SD of variable NPRS at 24 - , 36 - and 48 - hours following exercise protocol.

Group	Mean	Std. Deviation
Cryotherapy and stretching (Group - A)	Age	22.70
	NPR 24 Hours	6.00
	NPR 36 Hours	3.80
	NPR 48 Hours	0.80
IRR and stretching (Group - C)	Age	22.00
	NPR 24 Hours	6.90
	NPR 36 Hours	5.40
	NPR 48 Hours	2.20
Control Group (Group - C)	Age	21.80
	NPR 24 Hours	8.80
	NPR 36 Hours	7.40
	NPR 48 Hours	5.90



Graph 2: Mean of NPRS after 24, 36 and 48 hours

Table 2: Within group comparison for Group A - Cryotherapy and stretching

	Mean	SD	F Value	P value
NPRS 24 Hours	6.00	0.82	278.73	<0.001
NPRS 36 Hours	3.80	0.63		
NPRS 48 Hours	0.80	0.63		

The sample size for Group A was taken as (N =10). NPRS mean and standard deviation at 24 hours, 36 hours and 48 hours were 6.00 ± 0.82, 3.80 ± 0.63 and 0.80± 0.63. The F value 278.73 which is statistically significant (p<0.001).

Table 3: Within group multiple comparison for Group A - Cryotherapy and stretching

Tukey Kramer Multiple comparison Test	Mean Difference	Tukey Kramer Value	P value
24 hrs. Vs.36 hrs.	2.2	14.071	<0.01
24 hrs. vs 48 Hrs.	5.2	33.259	<0.01
36 hrs. Vs 48 Hrs.	3	19.188	<0.01

The mean difference in group A (Cryotherapy and stretching) between 24 hours – 36 hours, 24 hours – 48 hours and 36 hours – 48 hours were 2.2, 5.2, 3.0. which is statistically significant (p<0.01).

Table 4: Within group comparison for Group B - IIR and stretching

	Mean	SD	F Value	P value
NPRS 24 Hours	6.90	0.88	219.17	<0.001
NPRS 36 Hours	5.40	1.17		
NPRS 48 Hours	2.20	0.63		

The sample size for Group B was taken as (N =10). NPRS mean and standard deviation at 24 hours, 36 hours and 48 hours were 6.90 ± 0.88, 5.40 ± 1.17 and 2.20± 0.63. the F value 219.17 which is statistically significant (p<0.001).

Table 5: Within group multiple comparison for Group B - IIR and stretching

Tukey Kramer Multiple comparison Test	Mean Difference	Tukey Kramer Value	P value
24 hrs. Vs.36 hrs.	1.5	9.25	<0.01
24 hrs. vs 48 Hrs.	4.7	28.98	<0.01
36 hrs. Vs 48 Hrs.	3.2	19.73	<0.01

The mean difference in group B (IIR and stretching) between 24 hours – 36 hours, 24 hours – 48 hours and 36 hours – 48 hours were 2.2, 5.2, 3.0. which is statistically significant (p<0.01).

Table 6: Within group comparison for Group C - Control Group

	Mean	SD	F Value	P value
NPRS 24 Hours	8.80	0.63	71.89	8.80
NPRS 36 Hours	7.40	0.70		
NPRS 48 Hours	5.90	0.74		

The sample size for Group C was taken as (N =10). NPRS mean and standard deviation at 24 hours, 36 hours and 48 hours were 8.80 ± 0.63, 7.40 ± 0.70 and 5.90± 0.74. The F value 71.89 which is not statistically significant (p>0.001).

Table 7: Within group multiple comparison for Group C - Control Group

Tukey Kramer Multiple comparison Test	Mean Difference	Tukey Kramer Value	P value
24 hrs. Vs.36 hrs.	1.4	8.18	<0.01
24 hrs. vs 48 Hrs.	2.9	16.94	<0.01
36 hrs. Vs 48 Hrs.	1.5	8.76	<0.01

The mean difference in group C (Control group), between 24 hours – 36 hours, 24 hours – 48 hours and 36 hours – 48 hours were 1.4, 2.9, 1.5. which is statistically significant (p<0.01).

Table 8: Between group Comparison of NPR

	Mean	Std. Deviation			
	Mean	Std. Deviation	Std. Error	F	P
Group A	5.20	0.79	0.25	23.801	<0.001
Group B	4.70	0.67	0.21		
Group C	2.90	0.88	0.28		

Table 9: Between groups Comparison of NPR

(I) group		Mean Difference (I - J)	Std. Error	Sig.
Group A	Group B	.5000	.3507	.3421
	Group C	2.3000*	.3507	<0.001
Group B	Group A	-.5000	.3507	.3421
	Group C	1.8000*	.3507	.0001
Group C	Group A	- 2.3000*	.3507	<0.001
	Group B	- 1.8000*	.3507	.0001

5. Discussion

DOMS (delayed onset muscle soreness) occurs after vigorous and unaccustomed resistance training or any other form of muscular overexertion. DOMS are noticeable in the muscle belly or at any myotendinous junction [18]DOMS appear approximately after 12 to 24 hours after the cessation of exercise. There were following theories which resulted in etiology of DOMS. [18]

There are various types of application of cryotherapy: Ice pack, Ice spray, Immersion, Ice massage. It is believed that our fascia can tighten; constricting our muscles, decreasing blood supply, causing pain and decreasing range of movement. It's not exactly known why fascia can tighten, but osteopathic theory suggests that tightness may be caused by overuse, disease, trauma, infection or inactivity. Stretching is a form of physical exercise in which specific muscle or tendon is deliberately flexed or stretched in order to improve the muscles felt elasticity and achieve comfortable muscle tone. There are various types of stretching: Ballistic stretching, dynamic stretching, Active stretching, passive stretching, Isometric stretching, and PNF stretching. The present study was designed to compare the effect of cryotherapy and stretching vs. effect of IRR and stretching in exercise and compare with control group after induced DOMS i. e., delayed onset muscle soreness. In this study group A shows better result compare to group B and C. so cryotherapy and stretching was more effective than IRR and stretching or no treatment.

The main pathology in muscle soreness is that there is micro trauma to the muscle because of that there is mechanical disruption of muscle fibres/ connective tissue that results in

the degeneration of the tissue. [18]Evidence of tissue damage such as increase in blood serum of creatinine kinase and also inflammation and edema are seen. [18] Delayed onset muscle soreness i. e., DOMS induces in the muscle after 24 to 48 hours of strenuous exercise/workout. [18]In group A i. e., cryotherapy and stretching the application of ice on to a surface reduces the blood supply to that particular area due to vasoconstriction. [19]Due to this there is decrease in inflammation and also reduce risk of swelling and tissue damage. [19] The application of ice to an area also gives an effect of, it numbs the sore tissue and acts as a local anesthetic. [20]It reduces the pain message being transmitted to the brain. [21]In addition to cryotherapy in group A stretching was also given to the targeted muscle. Although, the combination of the two treatments cryotherapy and stretching was much more effective in immediate treatment of delayed onset muscle soreness. Although, the combination of the two treatments IRR and stretching was not as effective as cryotherapy and stretching in immediate treatment of delayed onset muscle soreness.

6. Conclusion

This study found that both cryotherapy with stretching and infrared radiation with stretching are effective in preventing exercise - induced Delayed Onset Muscle Soreness DOMS. However, cryotherapy with stretching showed a greater effect in preventing DOMS compared to infrared radiation with stretching.

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