"EFFECT OF FOAM ROLLING FOLLOWED BY CRYOTHERAPY VERSUS CRYOTHERAPY FOLLOWED BY FOAM ROLLING ON PAIN AND RANGE OF MOTION FOR DELAYED ONSET MUSCLE SORENESS IN AMATEUR BODY BUILDERS" A COMPARATIVE STUDY

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Abstract: BACKGROUND: DOMS develops after resistance training especially after the increase in intensity and volume of training, the order of exercise is changed or a new training regime is performed. Different cryotherapies–such as Cold water immersion and ice packs–have been used for post-exercise recovery in a variety of sports. Purpose of this study was to assess whether foam rolling or cryotherapy is the first line treatment for DOMS on elbow flexor in amateur body builders.

METHODOLOGY: Twenty amateur body builders both males and females with 6 months of resistance training were included in the study. Inclusion and exclusion criteria were assessed, informed consent was obtained and ethical clearance was obtained from the institution. Subjects were then divided into 2 groups, group A (n=10) cryotherapy followed by foam rolling. Group B (n=10) foam rolling followed by cryotherapy. Pre-and post-measurement was taken by VAS for pain and goniometer for ROM.

RESULTS: Group A received cryotherapy followed by foam rolling showed mean reduction in pre-VAS score of 6.9 to post score of 4.5 and pre-ROM for elbow flexion mean score of 89 improved to post score of 127.2. Group B received foam rolling followed by cryotherapy which showed mean reduction in pre-VAS score of 7 to post score of 3.5 and pre-ROM for elbow flexion mean score of 92.1 improved to post score of 118.9.

CONCLUSION: Foam rolling followed by cryotherapy resulted in decrease in pain significantly. Cryotherapy followed by foam rolling had a significant effect in increase in ROM rather than reduction in pain.

KEYWORDS: DOMS, Foam rolling, Cryotherapy

I. INTRODUCTION

Delayed-onset muscle soreness (DOMS) is pain or discomfort that classically occurs 1–2 days after unaccustomed eccentric loading of skeletal muscle and generally, resolves within a week of the inciting activity. Recreational and elite athletes experience DOMS after unaccustomed exercise involving an eccentric muscle-loading factor and this occurs often after the introduction of a new phase or type of workout. [1]It is classified as a type 1 muscle strain, produces tenderness or stiffness to palpation or movement, and predominantly is seen in or amplified by unaccustomed exercise. Sensations associated with DOMS are highly variable and range from slight muscle stiffness that subsides with regular daily activity to severe debilitating pain that restricts any movement.[2] DOMS often develops after resistance training especially after the intensity and volume of training are increased, the order of exercise is changed or a new training regime is performed. The exercise-induced DOMS model imitates the cellular and functional processes observed in acute musculoskeletal injury. Such processes include loss of ROM and strength, resting pain, disability with activities of daily living, and localized swelling followed by signs of healing within 72 hours of injury. [3] Whether the DOMS is the result of injury to the muscle or edema independent of muscle injury, the affected muscles are not able to exert as much force when the person is asked to apply maximal force, such as in the performance of 1 RM strength test. Failure in excitation-contraction coupling appears to be the most important, particularly during the first 5 days. [4]

Foam rolling is the most commonly used practice for recovery among the body builders. It is a form of self-myofascial release therapy in which the individual applies a direct pressure to the affected area using a foam roller.[5] Foam rolling can be considered a form of self-induced massage because the pressure that the roller exerts on the muscles resembles the pressure exerted on the muscles through manual manipulation by a massage therapist. [2]

For decades, different cryotherapies–such as cold-water immersions (CWI) and ice packs–have been used for post-exercise recovery in a variety of sports to cope with fatigue and/or DOMS. In the context of this paper, Cryotherapy is defined as immersion in the water below 15 degree Celsius.[6] Cooling showed significant effects in reducing the symptoms of DOMS (up to 96 hrs) when compared to passive control interventions. CWI achieved the best effect with respect to the other cooling applications. [7]

There are several studies on management of delayed onset muscle soreness, both in clinical and rehabilitation aspect, in that foam rolling and cryotherapy has been proved beneficial in reducing pain and improving flexibility, but none of the study shows which sequence of treatment to follow to have a better form of treatment strategy. This study is trying to prove whether foam rolling followed by cryotherapy or cryotherapy followed by foam rolling has an effect on pain and ROM of the elbow flexors in amateur body builders.

The objectives of the study were:

a) To find out the effect of foam rolling followed by cryotherapy on pain and range of motion on DOMS in amateur body builders.

b) To find out the effect of cryotherapy followed by foam rolling on pain and ROM for DOMS in amateur body builders.

c) To find out whether Foam rolling followed by cryotherapy or cryotherapy followed by foam rolling had a better effect on pain and range of motion in amateur body builders.

II. Methodology and Procedure

Subjects consisting of 20 healthy individuals (13 males and 7 females) between the age group 18-45years with minimum 2 days of weight training per week [8] were included in the study using convenience sampling. The study was approved by institutional ethical committee Dayananda Sagar Institute, Bangalore. Exclusion criteria included any history of abnormal heat or cold sensitivity, poor circulation, or peripheral vascular disorders; Participants on a muscle relaxant, anti-inflammatory, or analgesic medications; Cardiovascular or orthopedic contraindications to resistance exercise and had applied topical medication within 24 hours of enrollment. Informed consent was obtained from the enrolled subjects. Subjects were then divided into two groups, group A (10 subjects) received cryotherapy followed by foam rolling, and group B (10 subjects) received foam rolling followed by cryotherapy.

2.1 Exercise Protocol for DOMS Induction

General arm movement was performed for five minutes before the exercise for induction of DOMS. After that, subjects were seated on the stool with their back supported against the wall. All subjects performed an eccentric exercise of the non-dominant elbow flexor muscles using a dumbbell. Subjects were instructed to lower the dumbbell from elbow flexed (50 degrees) to an elbow extended position (170 degrees) in 4-5 seconds, keeping the velocity as constant as possible by following the examiner counting '0' for the beginning and '1, 2, 3, 4, 5' during movement. After each eccentric action, the examiner removed the load and them arm was returned to the starting position. The movement was repeated after every 45 seconds for 30 repetitions. This long interval between the repetitions minimized the effect of fatigue. Subjects were verbally guided to lower the dumbbell for constant velocity for the whole ROM. [9]

2.2 Pain

Muscle soreness was evaluated using a visual analog scale (VAS). The subjects were asked to indicate their perceived level of muscle pain (soreness) in the non-dominant elbow flexor muscle on the line when an investigator extended the elbow joint. The visual analog pain scale consists of a 10-cm line with descriptors at each end. At the left end, there is the number zero with the descriptor no soreness at all and at the right end, there is the number ten with the descriptor soreness as bad as it could be. The visual analog pain scale has been used as a valid and reliable measurement for determining the intensity of pain in human subjects. [10]

2.3 Elbow joint angles and ROM

The subject in supine lying with shoulders in zero degrees of flexion, extension, and abduction so that the arm is close to the side of the body. A pad will be placed on the distal end of the humerus to allow full elbow extension. The forearm should be placed in full supination. Center the fulcrum of the goniometer over the lateral epicondyle of the humerus. The proximal arm should be aligned with the lateral midline of the humerus, using the center of the acromion process for reference. The distal arm should be aligned with the lateral midline of the radius using the radial styloid process as the reference. The subject will be asked to perform flexion of the elbow and the range of motion should be measured.[11]

2.4 Intervention

The Grid Foam Roller (Trigger Point Technologies, 38cm in length & 13cm in diameter), which is composed of a uniform cylinder with a hard, hollow inner core enclosed with a layer of ethylene vinyl acetate foam was used for intervention. This type of roller appears to produce more pressure on the soft tissue than traditional foam roller made out of polystyrene foam.[12] Subjects were informed of the protocol and were given a brief introduction to the foam rolling procedure. Foam rolling was performed for 60 seconds duration reflecting the minimum dose prescribed by physiotherapy professionals working with the athletes. [13] Cold water immersion of the arm for 3 periods of 5 minutes around 15degrees Celsius. [14]

III. STATISTICAL ANALYSIS

All the data obtained from the two groups were tabulated. Statistical analysis was performed by using SPSS software for Windows (version17) and p value was set as 0.05. Chi-square test and paired t-test was used to analyze baseline data for demographic variable for gender and age respectively. Wilcoxon test was used to analyze VAS within the group. Paired t-test was used to analyze ROM within the group. Mann-Whitney U-test was used to analyse VAS between the groups A and B. Unpaired t- test was used to analyse the ROM between the groups.

IV. RESULTS

Table I: Baseline data for demographic variables

SL.No.	Variables	Group A	Group B	þ-value
1	Age	21.60±2.22	21.30±0.77	>0.742
2	Gender(M/F)	6/4	7/3	>0.500

The table shown above are mean and standard deviation(SD) for age and gender. Mean age of group A was 21.60 with SD of 2.22 and in group B mean age of 21.30 with SD 0.77 which was statistically not significant (p>0.742). The group A had 6 males and 4 females whereas group B had 7 males and 3 females which were found to be statistically not significant (p>0.500).

Table II: Baseline data for outcome variables

SL.No	Variables	Group A	Group B	þ-value
1	VAS	6.90±0.88	7.00±0.67	>0.791
2	ROM	89.00±8.79	92.10±7.77	>0.415

The table shown above are mean and SD for Pain and ROM. Mean VAS of group A was 6.9 with SD of 0.88 and group B mean VAS was 7 with SD 0.67 which are statistically not significant (p>0.791). The mean ROM for group A was 89.0 with SD of 8.79 whereas in group B mean ROM was 92.1 with SD of 7.77 which are statistically not significant(p>0.415).

Table III: Pre-post data within Group A

SL.No	Variables	Pre	Post	þ-value
1	VAS	6.90±0.88	4.50±0.53	<0.004
2	ROM	89.00±8.79	127.20±3.68	<0.0001

The table shown above depicts pre- post data of Pain and ROM within group A. The mean pre-VAS of 6.9 with SD of 0.88 and mean post- VAS of 4.5 with SD of 0.53 which are statistically significant (p<0.004). The pre-ROM mean was 89.0 with SD of 8.79 and post-ROM mean of 127.2 with SD 3.68 which are statistically significant (p<0.0001).

Table IV: Pre-post data within Group B

SL.No	Variables	Pre	Post	þ-value
1	VAS	7.00±0.67	3.50±0.53	<0.005
2	ROM	92.10±7.77	118.90±4.95	<0.0001

The table shown above depicts pre- post data of VAS and ROM within group B. The mean pre-VAS was 7.00 with SD of 0.67 and mean post- VAS of 3.5 with SD of 0.53 which are statistically significant (p<0.005). The pre-ROM mean was 92.1 with SD of 7.77 and post-ROM mean of 118.9 with SD 4.95 which are statistically significant (p<0.0001).

Table V: Difference between groups for outcome variables

SL.No	Variables	Group A	Group B	þ-value
1	VAS	4.50±0.53	3.50±0.53	<0.003
2	ROM	127.20±3.68	118.90±4.95	<0.0001

The table shown above depicts VAS and ROM difference between groups A and Group B. The difference of mean VAS was 4.5 with SD of 0.53 and group B was 3.5 with SD of 0.53 which was statistically significant (p<0.003). The difference of group A mean ROM was 127.2 and SD of 3.68 and group B was 118.9 and SD of 4.95 which was statistically significant (p<0.0001).

V. DISCUSSION

The purpose of this study was to assess whether foam rolling or cryotherapy is the first line treatment for DOMS on elbow flexor in amateur body builders. Bodybuilders mainly focus on gaining muscle growth and symmetry and hence recovery from DOMS becomes an essential part. Also, improvement in flexibility helps to prevent injuries during training. Studies have shown both cold water immersion and foam rolling to be effective against DOMS and are one of the most widely used therapeutic techniques among body builders. Cold water immersion is used to reduce inflammation and speed recovery and foam rolling have been proven to increase acute ROM and hence improving flexibility. This study was an effort to obtain the best possible effect on recovery from DOMS after a heavy bout of resistance training on elbow flexors. Delayed-onset muscle soreness is characterized by variable amounts of muscle tenderness, stiffness, and pain that can fluctuate from slight muscle stiffness on palpation to severe debilitation of athletic performance.

The result of the present study showed both the groups with a significant statistical improvement of outcomes. In group A where cryotherapy was applied first followed by foam rolling showed a drastic improvement in ROM when compared to group B. The findings are consistent with the previous studies done by Macdonald et al. and Pearcey et al. where foam rolling effectively reduces DOMS and improves flexibility. This is hypothesised that after inducing DOMS immediately applying cryotherapy reduces inflammation and pain followed by application of foam rolling helps to improve muscle flexibility as foam rolling acts like self-myofascial release technique which in turn decreases swelling and eliminates metabolic waste products. Several study finding showed Cold water immersion has been used to treat musculoskeletal soreness with the expectation that reduces tissue temperature will result in vasoconstriction of small blood vessels in the muscles, thus diminishing inflammatory response and edema associated with musculoskeletal trauma secondary to sports or game activity. Complete cold water immersion of the affected muscle theoretically and clinically maximizes the therapeutic effect of the reduced temperature. Accordingly, cold water immersion is frequently used in sports medicine, particularly among high-level athletes, in an effort to minimise muscle soreness. Reports suggest that ice-water immersion may have a significant effect on muscle soreness after an intense or unaccustomed training session, allowing athletes to continue to train at peak intensity over subsequent days.

But in Group B foam rolling was applied immediately after DOMS was induced, this would effect to reduce swelling and improve ROM but the application of pressure using a foam roller may tend to increase the tenderness caused by the DOMS among the subjects. Followed by this cryotherapy was applied which aided in reducing pain considerably and had a lasting effect when compared to Group A. During foam rolling, individuals use their own body mass on a foam roller to exert pressure on the soft tissue. The motions place both direct and sweeping pressure on the soft tissue, stretching it and generating friction between it and the foam roller. Foam rolling can be considered a form of self-induced massage because the pressure that the roller exerts on the muscles resembles the pressure exerted on the muscles through manual manipulation by a massage therapist. Various postulated mechanisms may explain why foam rolling enhanced the recovery from muscle tenderness and associated dynamic performance measures throughout the 72 hours' post-exercise. The most common mechanisms are decreased edema, enhanced blood lactate removal, and enhanced tissue healing, which are mainly due to the increase in muscular blood flow. Increased blood flow hinders the margination of neutrophils and reduces prostaglandin production, subsequently decreasing inflammation. Massage-induced muscular blood flow also increases oxygen delivery, which encourages mitochondrial resynthesis of adenosine triphosphate and the active transport of calcium back into the sarcoplasmic reticulum.

The study had many limitations. We believe that an exercise-induced DOMS model is not an exact replica of clinical injury, mainly because the signs and symptoms are experimentally induced and usually resolve in a shorter time period. The participants enrolled in the study was limited. The duration of treatment and data collection was also less. This study is not gender specific. No follow up was done to see the long-lasting effect of the intervention.

VI. CONCLUSION

Evidence from the literature and results from this study led to the conclusion that there was a significant reduction in pain as compared to improvement in ROM of the elbow when foam rolling was followed by cryotherapy. There was significant improvement in ROM of the elbow when treated with cryotherapy followed by foam rolling as compared to decrease in pain.

VII. Abbreviations or symbols

DOMS- Delayed onset muscle soreness
ROM- Range of motion
RM- Repetitive maximum
CWI- cold water immersion
VAS- Visual analog scale

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