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Cryokinetic Intervention For An Individual Suffering From Muscular Fatigue Following Eccentric Exercises: A Case Study

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ABSTRACT

Background:

Muscle recovery following high-intensity eccentric exercises is a key focus in physiotherapy and athletic training. In this case study, cryokinetics- a combination of cryotherapy and therapeutic exercises, has been proposed as an effective intervention to enhance recovery.

Aim:

This case study investigated the effects of cryokinetic treatment on various parameters of muscle recovery like perceived recovery, muscle soreness, joint range of motion (ROM) and joint position sense (JPS).

Methods:

A 20-year-old male, who was physically active, was recruited in this case study after pre-exercise screening and baseline assessments, including anthropometric measurements, muscle soreness, perceived recovery, ROM and proprioception. The participant performed a high-intensity eccentric exercise protocol (5 sets of 10 repetitions on a leg press) using the dominant leg. Cryokinetics, consisting of 10 minutes of cold pack application followed by 10 minutes of free exercises, was administered 1-hour post-exercise and repeated at 24, 48, and 72 hours. Measurements were recorded before and after the intervention at each session.

Results:

The participant exhibited a significant increase in muscle soreness immediately after the high-intensity eccentric exercise, with visual analogue scale (VAS) rising to 8/10, accompanied by reductions in pain free joint ROM (35°) and increases in proprioception errors (6°). Cryokinetics showed a progressive reduction in muscle soreness, with VAS scores decreasing to 6/10 at 24 hours, 4/10 at 48 hours, and 2/10 at 72 hours. ROM showed a gradual recovery, returning to baseline levels by 72 hours. Similarly, proprioception errors improved progressively, decreasing to 4° at 48 hours and returning to 2° at 72 hours, matching baseline values. Perceived recovery scores improved markedly, starting at 4 post-exercise and reaching a full recovery score of 10 at 48 and 72 hours.

Conclusion: *This case study demonstrated that cryokinetics can provide substantial impact on muscle recovery following high-intensity eccentric exercises, effectively reducing muscle soreness, restoring joint function, and improving perceived recovery. These findings support the use of cryokinetics as a valuable recovery tool for athletes and individuals engaging in intense physical activity, warranting further exploration in larger studies.*

Keywords:

Cryokinetics, Cryotherapy, Eccentric contraction, High-intensity exercise, Muscle recovery

INTRODUCTION

Cryokinetics is defined as the coordinated application of cold and exercise in order to achieve therapeutic benefits [1]. In this technique, there is simultaneous delivery of cold to the associated tissues of the body followed by the active exercises of the associated muscles performed by the individual at a particular joint. It

aids in the reduction of pain and improvement of range of motion (ROM) as well as retaining muscular flexibility, strength, endurance and power [2]. Eccentric exercises involve the lengthening of the concerned muscles during forceful contractions-negatively affecting the muscle health as the resistance offered is greater than the muscular contractions initiated [3]. However, intense eccentric exercises can cause stretching of the musculo tendinous unit leading to delayed onset muscular soreness [4] and inflammation [5] as well as decreased joint ROM [6] and proprioception [7]. Post-exercise fatigue is commonly experienced by the individuals performing high-intensity eccentric exercises. It can be managed by several treatment methods like manual therapy, compression garments and heat therapy [8]. Common cold therapy techniques utilized for the management of this clinical condition includes cold water immersion, ice bags, swimming in cold water, partial and whole body cryo-stimulation are commonly used amongst the athletes [9-15]. However, there is conflicting evidence regarding these intervention measures [16].

Objective of the study

This case study aimed to find out the effects of cryokinetics on the parameters of muscle recovery after high intensity eccentric exercises. The parameters of muscle recovery included in the case study are pain, ROM, proprioception and perceived recovery by the participant.

CASE PRESENTATION

Participant

A 20-year-old male who was regularly visiting university gymnasium was recruited for this case study after obtaining his informed consent. The detailed procedure of the study and potential benefits of the participation was explained to the participant. The participant was a moderately physically active individual and was habitual of performing eccentric exercises on the leg- press machine. Figure 1 describes the protocol of the study.

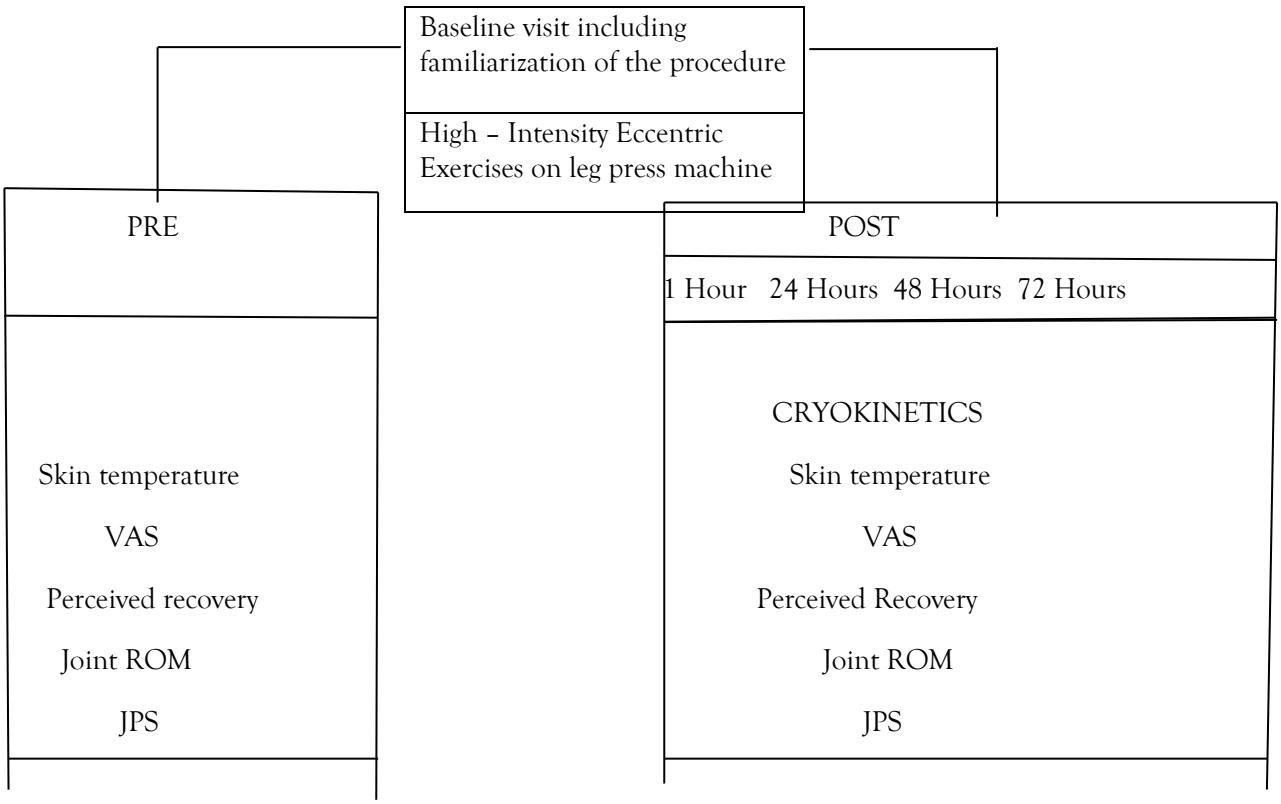

Figure 1: Experimental Design: Representation of the experimental design of the study. Abbreviations: VAS (Visual Analogue Scale), ROM (Range of Motion), JPS (Joint Position Sense), EMG (Electromyography). Cryokinetics was performed 1 hour immediately after high- intensity eccentric exercises and after every subsequent visit following 3 days of high- intensity eccentric exercises.

The participant was screened for any underlying complications. The participant was instructed to visit the university gymnasium for 5 times for baseline examination, conducting exercise protocol and cryokinetic intervention.

METHOD AND PROCEDURE

Physical Activity Readiness Questionnaire (PAR-Q) was filled by the participant in order to conduct pre-exercise screening. The participant was required to visit the gymnasium of the University, five times a week. During the baseline visit familiarization of the testing equipment (leg press machine), determination of 5 Repetition Maximum (RM) along with baseline measurements like anthropometric measurements, skin temperature, perceived muscle soreness, joint ROM as well as JPS was recorded. Anthropometric measurements include height, weight and Body Mass Index (BMI). Table 1 describes the demographic characteristics of the participant. Skin temperature was recorded by contact infrared laser gun thermometer, delayed onset muscle soreness (DOMS) was assessed by VAS, perceived recovery was recorded on "recovery scale" and joint ROM was recorded by simple goniometer, JPS was recorded by "goniometry" via criterion angle reproduction.

Table 1: Demographic characteristics of the participant

Variables	**Values**
Age	20 years
Height	164 cms
Weight	56.2 kgs
BMI	20.72 kg/m^2
1 RM leg press	50 kgs

The subsequent visit was planned seven days following baseline visit. In this visit, high-intensity eccentric exercise i.e. 5 set of 10 eccentric single – leg press repetitions on a leg press machine was performed. A rest period of 3 minutes was provided between each set during which the dominant leg on the participant will be utilized for performing unilateral contractions and both legs was used to raise the weight concentrically before performing each eccentric contractions. Each eccentric contraction was of 3-5 seconds duration during which participant resists the load with the dominant leg from full extension to 90 degrees of flexion. All the baseline measurements were repeated before high- intensity eccentric exercise protocol and following one hour after delivering the cryokinetics treatment. Cryokinetics was delivered by applying standard cold packs wrapped under the towel for 10 minutes around the knee joint followed by 10 minutes of free weight exercises (ROM exercises of the knee joint for 05 minutes and static cycling for 05 minutes). Figure 2 illustrates the participant performing high- intensity eccentric exercises on the leg- press machine and figure 3 illustrates application of cryokinetics respectively.

Figure 2: Participant performing high – intensity eccentric exercise protocol on a leg press machine.

(A) (B)

Figure 3: (A) shows participant performing free- weight exercises on static cycle and (B) shows application of cold pack.

The third visit was after one day (at 24 hours) during which the cryokinetics treatment was provided. At the third visit also, the baseline measurements were repeated. The fourth visit was after two days (48 hours) following high- intensity exercises protocol during which cryokinetic delivered and again baseline measurements was recorded. The fifth and last visit was after three days (72 hours) following high- intensity exercises protocol during which cryokinetic protocol was delivered and again baseline measurements were recorded.

RESULTS

The participant exhibited a significant increase in muscle soreness immediately after the high-intensity eccentric exercise, with VAS rising to 8/10, accompanied by reductions in ROM (35°) and increases in proprioception errors (6°). In this case study, cryokinetics showed a progressive reduction in muscle soreness, with VAS scores decreasing to 6/10 at 24 hours, 4/10 at 48 hours, and 2/10 at 72 hours. ROM showed a gradual recovery, returning to baseline levels by 72 hours. Similarly, proprioception errors improved progressively, decreasing to 4° at 48 hours and returning to 2° at 72 hours, matching baseline values. Perceived recovery scores improved markedly, starting at 4 post-exercise and reaching a full recovery score of 10 at 48 and 72 hours. Table 2 summarizes the values of the outcome measures pre and post intervention.

Table 2: Values of pre- treatment and post treatment outcome measures during the cryokinetics intervention

S.No.	Outcome measure	Baseline Values	Pre – High Intensity Eccentric Exercises Protocol Values	After 1 hour of High Intensity Eccentric Exercises Protocol Values	After 24 hours of High Intensity Eccentric Exercises Protocol Values	After 48 hours of High Intensity Eccentric Exercises Protocol Values	After 72 hours of High Intensity Eccentric Exercises Protocol Values
1.	Skin Temperature	27.3^0	27.4^0	23.1^0	24^0	23^0	23^0
2.	VAS	0/10	0/10	8/10	6/10	4/10	2/10
3.	Perceived Recovery	N/A	N/A	4	8	10	10
4.	Joint ROM	130^0	130^0	75^0	95^0	120^0	130^0
5.	JPS position error	2^0	2^0	6^0	6^0	4^0	2^0

DISCUSSION

This case study described a 20 – years old male who performed high- intensity eccentric exercises under supervision. Eccentric exercises are commonly performed by the individuals at gymnasium or by the sports person. However, delayed onset muscular soreness can occur from unaccustomed eccentric exercises. The treatment of post- exercise fatigue is still controversial. There exists a literature gap in the evidences regarding cryokinetics for the management of exercise induced muscular soreness. Previous studies showed significant improvement with cryokinetics amongst the various musculoskeletal disorders. A RCT (randomized controlled trial) was conducted on the ankle sprain patients incorporating two groups Group A (standard cryotherapy group) and Group B (cryokinetic treatment group), they concluded that cryokinetic intervention is cost effective method of reducing pain and swelling [8].

Another RCT study was conducted on patients with achilles tendinopathy in which two groups (A and B) were made delivering ultrasonic therapy with cryokinetics and ultrasonic therapy with soft tissue massage respectively. They founded that group B have significant improvement than group A with respect to pain and functional improvement [17]. Similarly, three RCT's was conducted on the supraspinatus tendonitis patients. Each study made two groups in which one group was experimental and another group was control. They reported that cryokinetics significantly reduced the pain, ROM and muscular strength of the shoulder [18-20]. This case study results were supporting the findings of the previous studies with respect to pain, ROM and perceived recovery. An experimental study was conducted on the hemophilia patients delivering cryokinetics and they founded that cryokinetics aids in the improvement of proprioception of the knee joint

[7] .The results of this case study corresponds to their findings with respect to improvement in joint proprioception. Effects of cryokinetics were also studied in the three RCT's on the upper spinal cord injury patients and demonstrated improvement in their functional recovery [21-23]. This corresponds to the results of this study with respect to the functional recovery. This case study seems to be unique as it represents the beneficial effects of cryokinetics on the exercise induced fatigue and soreness. This study has several limitations including limited outcome measures because post- exercise fatigue is also dependent on biochemical parameters. The sample size is limited to one participant only. Future studies can be performed with greater sample size and with randomized controlled groups. Further studies should consider the variations of biochemical parameters like creatine kinase and lactic acid, before and following the intervention.

CONCLUSION

This case study concludes that cryokinetics can improve and resolve the symptoms of post- exercise fatigue. This treatment technique aids in the muscle recovery following high- intensity eccentric exercises. Since, delayed onset muscle soreness usually improves over a period of 48-72 hours, it is possible that healing taking place via natural recovery. However, more studies are required to confirm the existing findings.

Implications

These findings support the use of cryokinetics as a valuable recovery tool for athletes and individuals engaging in intense physical activity, warranting further exploration in larger studies.

ETHICAL CONSIDERATIONS

Compliance with ethical guidelines

Informed consent was taken by the participant prior to recruitment. Ethical approval from the Institutional Ethics Committee of the School of Medical Sciences and Research, Sharda University, Greater Noida, Uttar Pradesh, India was taken prior to the conduct of the study (Ref. No. SU/SMS&R/76-A/2024/16).

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Author Contributions

Both the authors contributed equally in conceptualization, methodology, investigation, writing- original draft, writing- review &editing and manuscript preparation.

Conflict of Interest

The authors declared no conflict of interest.

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