

## Efficacy of Cryotherapy versus Conventional TENS in Reducing Pain Level in Exercise Induced Delayed Onset Muscle Soreness in Normal Subjects

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### Abstract

**Background:** Following an extended lay off from exercise, most people experience soreness in the exercised muscles. Temporary soreness may persist for several hours immediately after unaccustomed exercise, whereas residual delayed onset muscle soreness appear late and can last for 7 days. DOMS is a common problem seen in the athletes and even normal people following unaccustomed work. Pain and reduction in performance may interfere with day to day activities. So treatment is required which will reduce pain in minimum time limit. Delayed onset muscle soreness is a widely recognized and yet controversial injury phenomenon both in terms of origin, cause of injury and treatment. **Objectives:** To evaluate Reduction of pain after giving Cryotherapy in subjects induced with DOMS, to evaluate reduction of pain after giving TENS in subjects induced with DOMS, to find out whether Cryotherapy or conventional TENS is more effective in reducing the pain levels in delayed onset muscle soreness. **Methodology:** After signing informed consent, sixty subjects were selected and 30 subjects were assigned in Group A received Cryotherapy and 30 subjects to group B received Conventional TENS. **Result:** This study showed that statistically significant reduction in pain in DOMS by using Cryotherapy and Conventional TENS. TENS is more effective than cryotherapy in reducing pain in DOMS. **Conclusion:** This study concluded that both the modalities reduced pain effectively but TENS is more effective than cryotherapy in reducing pain in DOMS. **KEYWORDS:** Cryotherapy, Conventional TENS, Pain, Exercise, Delayed Onset Muscle Soreness.

### INTRODUCTION

Following an extended lay off from exercise, most people experience soreness in the exercised muscles. Temporary soreness may persist for several hours immediately after unaccustomed exercise, whereas residual delayed onset muscle soreness appear late and can last for 7 days.

#### Definition:

DOMS is muscular pain or discomfort that follows physical activity usually eccentric to which an individual is not accustomed i.e. the activity greater than normal individual's normal activity.

Other symptoms of this type of injury include decreased ROM and strength. The soreness usually begins 8 to 24 hours after exercises peaks between 24- 72 hours, post exercise and subside over next five to seven days. It should be differentiated from acute onset muscle soreness which begins during exercise and last for 6 hours after exercise.

**Any one of the following factors may produce DOMS:**

1. High tension causes damage to contractile component of muscle with accompanying release of creatinine kinase (CK), myoglobin (Mb) and Troponine, the muscle specific markers of muscle fiber damage.
2. Increased metabolism produced toxic waste product.
3. Increased temperature causes injury.
4. Altered nerve control resulting from deficiency of blood flow caused by constriction of blood vessels, initiate pain- spasm- pain cycle.

**Clinical features seen in DOMS**

1. Pain:

Pain and tenderness is one of the main factor associated with DOMS .The inflammation process is accompanied by release of substances such as bradykinin ,histamines and prostaglandins , which all can sensitize and activate the nociceptors .This occurs from both chemical and mechanical point of view.

2. Residual swelling and stiffness:

Initial stiffness is a due to disturbances of calcium homeostasis that is associated with DOMS and that swelling could contribute to stiffness in later stages.

3. Inflammation:

Not true is inflammatory response as not all not inflammatory mediators have been found.

4. Soreness:

The musculotendonous junction is a most commonly reported as the point where DOMS are experienced as most intense.

**Eccentric Action Produce Muscle Soreness**

In one study, subjects rated muscle soreness immediately after exercise and 24, 48 and 72 hours later. Greater soreness resulted from exercise involving repeated intense strain during active lengthening in eccentric action then from concentric and isometric action. Soreness did not relate to lactate buildup ,because high intensity ,level running (concentric action) produce no residual soreness despite significant elevation of blood lactate .In contrast ,downhill running (eccentricaction )caused severe DOMS without lactate elevation during exercise.

**Mechanism of Damage**

The first bout repetitive high force eccentric exercise disrupts the integrity of sarcolemma to produce mitochondrial swelling and temporary ultra structural muscle damage. The subsequent decrease in muscle performance for several days after eccentric injury is related to failure in excitation contraction coupling. The fast twitch fibers with low oxidative capacity show particular vulnerability.

## Altered Sarcoplasmic Retention

Change in pH intramuscularly high energy phosphate, ionic balance or temperature with unaccustomed eccentric exercise produce major alteration in sarcoplasmic reticular structure and function. These effects depress the rate of calcium uptake and increase free calcium concentration. An overload of intracellular calcium may contribute to analytic process within damaged fibers thus reducing force capacity and eventually muscle soreness.

### Treatment

1) Medical Treatment: NASIDs

2) Physiotherapy Treatment:

- Rest
- Cryotherapy
- Massage to muscle
- TENS
- Infrared
- Light concentric exercise

### Pain Gate Mechanism:

Pain perception is regulated by gate which can be open and close by other input from central and peripheral nervous system. The nociceptive infrastructure is then carried by small diameter fibers C and A-delta fibers to substantia nigra (SN) and nucleus pulposus from where it is carried to cortex via midbrain. A-delta fibers have collateral to periaqueductal grey matter in midbrain which activates the descending pain suppression pathway which release enkephalin to suppress pain in SN.

1) Analgesic Effect of TENS in DOMS

The small diameter unmyelinated C fibers and A-delta fibers carry noxious impulses at frequency (1m/sec and 15 m/sec). Therefore by using even higher frequency current we can block the pain gate. Hence high frequency (100Hz to 200 Hz) low intensity conventional TENS can be effectively used. It will stimulate the A- beta fibers through mechanoreceptor and thermoreceptor. This A-beta fibers will impinge on the nociceptor cells of C-fibers and A-delta fibers and close pain gate.

The tissue damage pain in DOMS is mainly carried by the type IV C fibers. High frequency TENS causes presynaptic inhibition and physiological block in these fibers and is thus effective in reducing the pain in DOMS.

2) Analgesic Effect of Cryotherapy in DOMS

Application of ice will reduce edema and decreases release of pain inducing irritants (lactic acid). It will also prevent secondary cell necrosis by reducing metabolic rate during initial 2-4 hours of injury. Also will have direct effect on the conduction of pain receptor and neurons reducing the velocity and number of impulses. This will occur if temperature is not much reduced.

But the unmyelinated C-fibers carrying tissue damage pain (soreness) will not be affected by ice as they can continue to conduct at very low temperature.

### TENS Is More Effective Than Ice In Doms:

TENS is more effective in reducing pain in DOMS as compared to cryotherapy as it can directly block the C-fibers carrying pain in DOMS. Thus directly affecting the pain gate

mechanism in DOMS whereas Ice fails to block the C-fibers as these can continue to conduct at very low temperature also.

It can reduce pain effectively in initial hours after injury by reducing the metabolic Rate and hence secondary cell necrosis.

Thus it will not be much effective in reducing pain level in DOMS which usually occurs 24-48 hours after injury.

### **Anatomy of Biceps Brachii**

- a. Origin: Short head – Apex of coracoids process of scapula  
Long head – Supraglenoid tubercle of scapula
- b. Insertion: Tuberosity of radius
- c. Action: flexes the shoulder joint .With the origin fixed, flexes the elbow and supinates the forearm.
- d. Nerve supply: Musculocutaneous C5, C6.

DOMS was experimentally induced in Biceps brachii muscle unilaterally .Flexion and extension of elbow was done for 20 time lifting 2kg weight.

The soreness was recorded 48 hours after eccentric exercise and treatment given.

**Need for the study:** DOMS is a common problem seen in the athletes and even normal people following unaccustomed work. Pain and reduction in performance may interfere with day to day activities. So treatment is required which will reduce pain in minimum time limit. Delayed onset muscle soreness is a widely recognized and yet controversial injury phenomenon both in terms of origin, cause of injury and treatment.

### **OBJECTIVES:**

1. To evaluate Reduction of pain after giving Cryotherapy in subjects induced with DOMS
2. To evaluate reduction of pain after giving TENS in subjects induced with DOMS
3. To find out whether Cryotherapy or conventional TENS is more effective in reducing the pain levels in delayed onset muscle soreness

### **METHODOLOGY:**

#### **Sample Study**

Sixty patients in study are equally divided into

- Group A – 30 subjects
- Group B – 30 subjects

**Sampling Technique:** Simple randomized technique

**Duration of Study:**

**Duration of Treatment:**

- CRYOTHERAPY: 15 minutes, 1 session per day.
- CONVENTIONAL TENS: 15 minutes, 1 session per day

**Study Method:**

Sixty subjects were selected and 30 subjects are assigned in Group A. 30 subjects to group B and following treatment protocol was followed for each group.

### **Group A:**

Cryotherapy for 15 minutes each treatment session for biceps brachii muscle 48 hours after the experimentally induced DOMS.

### **Group B:**

Conventional TENS for 15 minutes each treatment session for biceps brachii muscle 48 hours after the experimentally induced DOMS.

### **Technique**

- Cryotherapy: Patient seated on a chair with elbow in complete extension, ice cube massage given for 15 min
- TENS: patient lying or sitting with elbow in complete extension, apply conventional TENS for 15 minutes over the biceps

**Assessment Tool:** VAS Scale, Ice pack, conventional TENS machine, weights of 2 kg

### **Inclusion Criteria:**

- Normal subjects with no biceps pain previously
- Subjects between the age group 16- 20 years of age

### **Exclusion Criteria:**

- Bicipital tendinitis
- Any previous pain in muscle
- Any sensory loss
- Myofascial syndrome
- Fibromyalgia

### **Null Hypothesis**

- There is no significant increase reduction in pain level after cryotherapy
- There is no significant increase reduction in pain level after TENS
- There is no significant increase reduction in pain level after both cryotherapy and TENS.

### **Alternate Hypothesis**

- There is significant increase reduction in pain level after cryotherapy
- There is significant increase reduction in pain level after TENS.
- There is significant increase reduction in pain level after both cryotherapy and TENS.

### **STATISTICAL ANALYSIS:**

Statistical analysis was done by using descriptive and inferential statistics using Student's paired and unpaired t test and software used in the analysis were SPSS 22.0 version and  $p < 0.05$  is considered as level of significance.

### **RESULTS:**

This study showed that statistically significant reduction in pain in DOMS by using Cryotherapy and Conventional TENS. TENS is more effective than cryotherapy in reducing pain in DOMS.

Table 1 showed comparison of pain on VAS in Cryotherapy group with baseline. Mean pain before exercise was 0, after exercise it was  $6.80 \pm 1.54$ , after 24-48 hours of exercise it was

5.86±2.08 and after treatment it was 2.86±1.27. By using student's paired t test statistically significant difference was found pain on VAS score after exercise ( $t=24.18$ ,  $p=0.0001$ ), after 24-48 hours of exercise ( $t=15.44$ ,  $p=0.0001$ ) and after treatment ( $t=12.27$ ,  $p=0.0001$ ).

Table 2 showed comparison of pain on VAS in Tens group with baseline. Mean pain before exercise was 0, after exercise it was 5.76±1.43, after 24-48 hours of exercise it was 6.16±2.27 and after treatment it was 1.33±0.99. By using student's paired t test statistically significant difference was found pain on VAS score after exercise ( $t=22.0718$ ,  $p=0.0001$ ), after 24-48 hours of exercise ( $t=14.84$ ,  $p=0.0001$ ) and after treatment ( $t=7.35$ ,  $p=0.0001$ ).

Table 3 showed comparison of pain on VAS in Cryotherapy and Tens group Student's unpaired t test. Mean pain on VAS score after exercise in cryotherapy group was 6.80±1.54 and in tens group it was 5.76±1.43. By using student's unpaired t test statistically significant difference was found in pain on VAS in two groups ( $t=2.69$ ,  $p=0.009$ ).

Mean pain on VAS score after 24-48 hours of exercise in cryotherapy group was 5.86±2.08 and in tens group it was 6.16±2.27. By using student's unpaired t test statistically no significant difference was found in pain on VAS in two groups ( $t=0.53$ ,  $p=0.59$ ).

Mean pain on VAS score after treatment in cryotherapy group was 2.86±1.27 and in tens group it was 1.33±0.99. By using student's unpaired t test statistically significant difference was found in pain on VAS in two groups ( $t=5.18$ ,  $p=0.0001$ ).

## DISCUSSION:

After in prolonged layoff from exercise, most people experience soreness in the exercise muscles.

DOMS occurring 24-48 hours after eccentric exercise is very common problem in amongst Athletes and common people affecting the daily functional activities. Therefore it is essential to relief pain effectively and quickly.

A purpose of my study is to know the difference of outcome of cryotherapy v/s TENS in reducing pain.

In this study 60 normal healthy students were randomly selected and DOMS was experimentally induced in them, divided into Group A and Group B and treatment was given.

Data was collected by using VAS scale for pain.

Statistical analysis was calculated using 't' test with 95% of significance.

## Pain

Cryotherapy (Group) - 't' test analysis showed reduction in pain level.

TENS (Group B) - 't' test analysis showed reduction in pain level.

Between both Group A and Group B - 't' test analysis showed significant statistical difference in reduction of pain. Hence TENS is more effective than cryotherapy in reducing pain in DOMS.

## CONCLUSIONS:

This study concluded that both the modalities reduced pain effectively but TENS is more effective than cryotherapy in reducing pain in DOMS.

**Possible mechanism of pain relief:**

- TENS can directly block C fibers carrying the tissue damage pain thus closing the pain gate in DOMS whereas ice fails to block the C fibers as these can continue to conduct at very low temperature also.
- Cryotherapy can reduce pain effectively in initial hours after injury by reducing metabolic rate and hence secondary cell necrosis.  
Thus, it will not be that much effective in reducing pain level in DOMS which usually occur 24-48 hours of exercise.

**REFERANCES:**

1. Denegar and Co-workers (1989) Influence of TENS on pain, range of motion and serum cortisol concentration in students experiencing DOMS. Journal of orthopedic and sports physical therapy.
2. Denegar, C.R., Perrin, D.H. (1989) Effect of TENS, cold, and combination treatment on pain decreased range of motion and strength loss associated with DOMS. Journal of Athlete training 21,200-206.
3. Denegar, C.R. and Huff, C.B., (1988). High and low frequency TENS in the treatment of induced musculoskeletal pain: a comparison study. Journal of Athlete training 23,235-237.
4. Isabell, W.K., Durrant, E., Myrer W. and Anderson, S. (1992) the effect of ice passage, ice massage with exercise and exercise prevention and treatment of DOMS. Journal of Athlete Training, 27,208-207.
5. Yackzan, L., Adams, C., Kennon, T.F. (1984) the effect of ice massage on DOMS. The American Journal of Sports medicine, 12, 159-165.
6. Lane Report (Aug 1998)
7. Old Dominion University Athletes (2000-02)

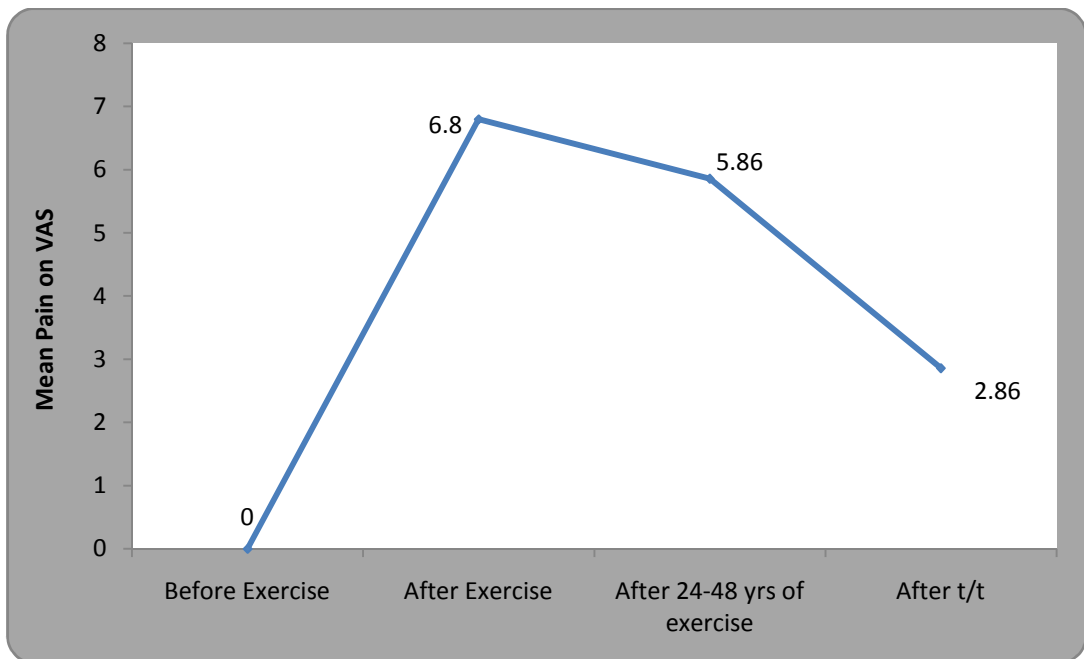
**Tables and Graphical Presentations:**

**Table 1: Comparison of pain on VAS in Cryotherapy group with baseline**

Student's paired t test

	Mean	N	Std. Deviation	Std. Error Mean	t-value	p-value
Before Exercise	0.00	30	0.00	0.00	-	-
After Exercise	6.80	30	1.54	0.28	24.18	0.0001,S
After 24-48 yrs of exercise	5.86	30	2.08	0.37	15.44	0.0001,S
After t/t	2.86	30	1.27	0.23	12.27	0.0001,S

**Graph 1: Comparison of pain on VAS in Cryotherapy group with baseline**



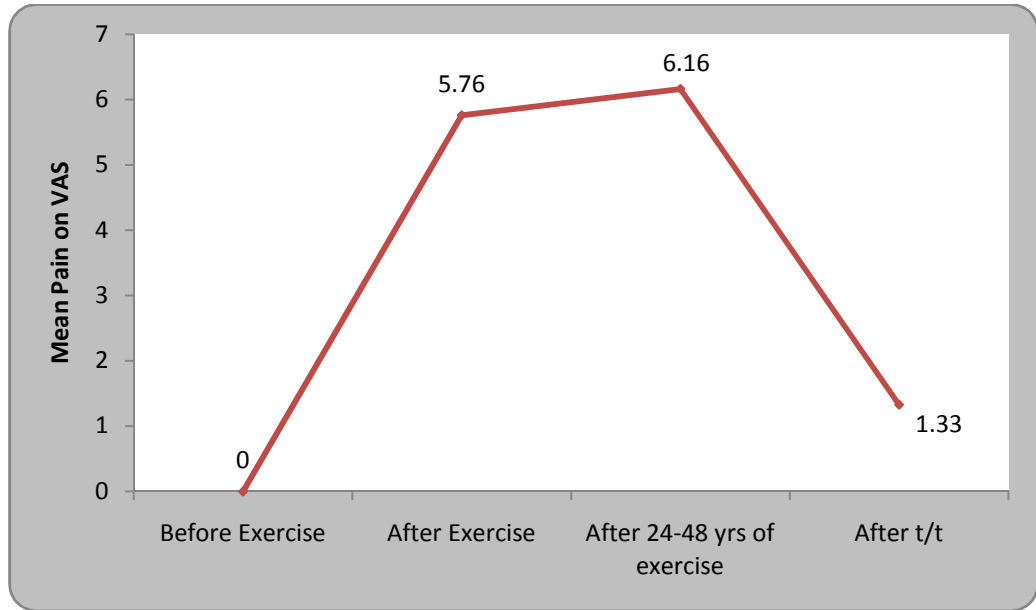
**Table 2: Comparison of pain on VAS in Tens group with baseline**

Student's paired t test

	Mean	N	Std. Deviation	Std. Error Mean	t-value	p-value
Before Exercise	0.00	30	0.00	0.00	-	-
After Exercise	5.76	30	1.43	0.26	22.07	0.0001,S
After 24-48 yrs of exercise	6.16	30	2.27	0.41	14.84	0.0001,S
After t/t	1.33	30	0.99	0.18	7.35	0.0001,S



**Graph 2: Comparison of pain on VAS in Tens group with baseline**



**Table 3: Comparison of pain on VAS in Cryotherapy and Tens group Student's unpaired t test**

	Cryotherapy		TENS		t-value	p-value
	Mean	SD	Mean	SD		
Before Exercise	0.00	0.00	0.00	0.00	-	-
After Exercise	6.80	1.54	5.76	1.43	2.69	0.009,S
After 24-48 yrs of exercise	5.86	2.08	6.16	2.27	0.53	0.59,NS
After t/t	2.86	1.27	1.33	0.99	5.18	0.0001,S

**Graph 3: Comparison of pain on VAS in Cryotherapy and Tens group**

