

Effect of transcutaneous electrical nerve stimulation (TENS) on delayed onset muscle soreness following eccentric exercises for elbow

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Abstract

Background: Delayed onset muscle soreness (DOMS) is usually experienced upon application of exercises which involve repetitive eccentric contractions. DOMS increases during the first 24- 48 hours, causing pain and reducing the range of motion of the affected region. Numerous therapeutic strategies have been identified for the management of DOMS, ranging from conservative to surgical, though evidence of their effectiveness is limited. Cryotherapy is one of the successful modalities used for managing DOMS, still the results are inconclusive. Therefore, the aim of the present study was to, determine the effects of transcutaneous electrical nerve stimulation (TENS) in addition to cryotherapy for the management of DOMS.

Methodology: An experimental study was carried out with 50 participants selected randomly and assigned to two groups: the experimental group receiving TENS and cryotherapy and the control group receiving only cryotherapy. The study design was approved by the institutional ethical committee. All participants received treatment three times a week for 8 weeks. The outcome measure was pain evaluated using the numerical rating scale.

Results: The results were analyzed using the Student's t- test to compare the differences between the experimental group and control group. The findings demonstrated significant effectiveness of TENS combined with cryotherapy.

Conclusion: The combined use of TENS and cryotherapy produces a significant pain reduction in DOMS.

Key words: TENS, cryotherapy, DOMS. eccentric exercises, numerical pain rating scale.

Introduction

Delayed onset muscle soreness (DOMS) is a type of muscle pain or discomfort experienced two to three days after exercises^[1]. It is felt after unusual physical activities and is largely seen among sportsmen, regardless of fitness levels^[2]. DOMS occurs as a result of microscopic tears in the muscle fibres following eccentric exercises, such as plyometrics, downhill running, and resistance training^[3].

During unaccustomed or vigorous exercises the muscles are overexerted at the myotendinous junction. DOMS usually develops within 12–24 hours after exercises, peaks 24–48 hours after an exercise bout and resolves within 96 hours^[4].

It reduces physical performance and is one of the major concerns for coaches and trainers^[3].

The management of DOMS includes several strategies to accelerate the recovery process. Various physiotherapy measures help in managing DOMS including laser therapy^[5], massage^[6], electrical stimulation, contrast bath and cryotherapy, which is considered the treatment of choice^[7].

Cryotherapy is one of the best modalities used to promote healing and to reduce pain^[8]. It helps in promoting the recovery between the training sessions and the competitive events^[9]. There is substantial evidence proving the effects of cryotherapy on DOMS; however, the actual mechanism has not been well understood.

Nevertheless, the study findings have demonstrated that prolonged use of cryotherapy aids in recovery^[10,11].

Cryotherapy helps to reduce the secondary hypoxic injury that may prevent subsequent swelling in the area, and thereby reduce pain^[12]. Cryotherapy causes constriction of blood vessels and lymphatics, which reduces the spread of fluid in the interstitial spaces, thereby minimizing inflammation, pain, oedema and muscle spasm^[13,14].

Transcutaneous electrical nerve stimulation (TENS) is found to be one of the modalities which play a role in pain reduction. Electrical stimulations have been applied for many centuries. They help to activate the complex neuronal network which reduces pain. According to numerous study findings, TENS stimulates large diameter afferent fibres helping to activate the descending inhibitory system to reduce hyperalgesia through the central and peripheral mechanism^[15]. Denegar et al. have reported a decrease in pain and an increase in the range of motion resulting from the application of TENS [18]. Otherwise, some studies have failed to demonstrate the efficacy of TENS in DOMS. Ikeuchi et al.,^[16] have found no beneficial effects of TENS on DOMS. Likewise, Jason et al.^[17] have not shown convincing evidence that TENS reduces pain in DOMS. Although there are so many studies on DOMS and its management, there is no consensus about the optimal treatment option. Therefore, this study was to compare the effects of cryotherapy combined with TENS versus cryotherapy alone on pain in DOMS.

Methods

The experimental study was conducted and its design was approved by the Institutional Ethical Committee. All the students from the college of health sciences (120) were initially recruited for preliminary assessment; following the screening, about 50 were selected for the study. The screening

was done by the physiotherapist not involved in this research. The participants were randomly divided into the experimental group (A) and control group (B) using the computer-assisted random sampling method. The inclusion criteria were volunteers aged 20-27 years, of both genders, with normal BMI, not involved in any other strengthening programme, without any medical treatment and any injury around the elbow, with no fear of electrical modalities. All the participants were provided with a clear explanation of the study rationale and gave their informed consent for participation. The one repetition maximum (1 RM) was recorded for each participant and the eccentric exercises were initiated depending on 1RM. Repeated eccentric exercises of the elbow flexors were carried out for 20 minutes; all participants used their dominant hand. Following the exercises, the participants were asked to rest for a short period and the exercises were continued for another 20 minutes. The participants were briefly informed about the symptoms of DOMS. On the subsequent day the participants complained of pain and spasm and were treated with respective therapies. The experimental group underwent TENS with cryotherapy. TENS (pulse rate of 90 pps) was applied for 10 minutes with a Neurotech NT 16 stimulator. The round carbon electrodes were fixed to the elbow muscles using electrode gel and secured with elastic wraps. During TENS the intensity was frequently increased to avoid accommodation of electric currents. Subsequently, a cryopack was applied over the painful area for 10 minutes. Home exercises for elbow flexor stretching were recommended. The treatment was carried out every alternate day. In the control group, a cryopack was applied over the painful area for 10 minutes and the home programme were advised. The protocol was followed every alternate day. The study was conducted for 8 weeks and subsequently the pain scores were calculated

using the NPR scale. The data of 44 participants (six - 3 in each group- left the study due to personal reasons) were analyzed using the Student's t- test. The results were compiled in detail.

Results

The baseline characteristics of all 44 participants were documented before the beginning of study.

The demographic variables of participants were presented in Table I and the schematic representation in Fig I. The paired t- test was used to determine whether there was any change in the pre- and post-test variables detailed in Table II . The Student t-test findings demonstrated significant differences between the study groups. (Table III, Fig. 2 - schematic representation).

Table I. Demographic variables

SN	Characteristics	Group A	Group B	Total number
1	Mean age (male)	23.5	23.25	24
2	Mean age (female)	24.1	23.1	20
3	Mean age (male) -groups A+B	23.38		44
4	Mean age (female) – groups A+B	23.60		

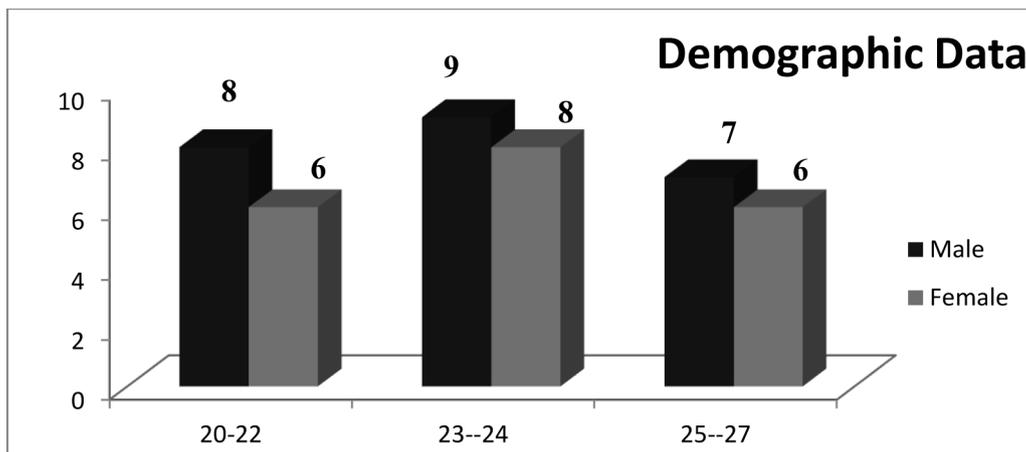


Fig. 1

Table II. Paired t-test analysis

Characteristics	Group A (Experimental Group)			Group B (Control Group)		
	Mean	Standard deviation	Paired t value	Mean	Standard deviation	Paired t value
Numeric Pain Rating Scale	5.36	1.00	25.1 (P <0.001%)	3.14	1.13	13.1 (P <0.001%)

Numeric Pain Rating Scale

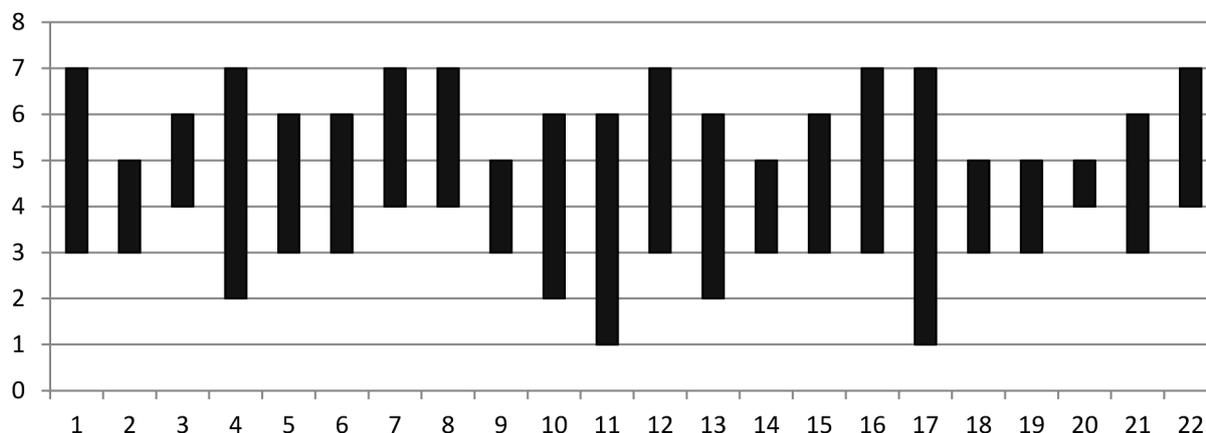


Fig. 2

Table III. Student t- test analysis

Characteristics	Group A & Group B post-test analysis		
	Mean	Standard deviation	Unpaired t value
Numeric Pain Rating Scale	2.18	0.759	9.54 (P <0.001%)

The mean NPR score in the experimental group (TENS combined with cryotherapy) was 6.09 in pre-test analysis and 0.727 in post-test analysis. The mean NPR score in the control group (TENS alone) was 6.05 in pre-test analysis and 2.91 in post-test analysis. The findings demonstrated significant changes in pain scores in both groups; however, post-test pain was slightly higher in the TENS group. The student's t-test result was found to be 9.54, which is a significant improvement in pain in both groups, yet the improvement observed in the experimental group was more pronounced than that found in the control group.

Discussion

DOMS results from unaccustomed physical activities that plague active individuals. It causes severe pain, spasm over the muscles, decreased function, and reduced range of motion in joints. Our study tried to determine whether TENS

combined with cryotherapy affected pain levels in DOMS. Numerous studies have clearly demonstrated that cryotherapy is one of the successful ways to manage DOMS^[19].

Cryotherapy produces a marked reduction in skin temperature, which is likely to constrict blood vessels, hence to result in more significant decreases in MVIC and SMVIC. Moreover, the application of cold contributes to the reduction in blood flow that suppresses haemorrhage and oedema formation in the accumulated area.^[20]

Cryotherapy decreases the metabolism in the injured tissues and reduces the secondary hypoxic injury^[20]. When the temperature is lowered, the oxygen demand of cells is also lowered which makes them less likely to be damaged by oxygen deprivation^[21].

TENS is a non-invasive treatment method, which acts locally at the site of application stimulating opioid and α -2 noradrenergic receptors

and thereby reducing pain ^[22]. Moreover, TENS shows analgesic effects through stimulation of the cutaneous afferent fibers at the site of application and differential blocking of primary afferents with local anesthetics ^[23].

According to Denegar et al., the combined use of TENS and cryotherapy significantly reduced pain and spasm associated with DOMS ^[18], which was also observed in our study. TENS combined with regular cryotherapy had more beneficial effects on pain relief in DOMS.

Conclusion

Transcutaneous electrical nerve stimulation combined with cryotherapy for the management of DOMS produces a significant pain reduction.

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Conflicts of Interest : none.

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