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Peter M. Tiidus
Wilfrid Laurier University, ptiidus@wlu.ca

Roula Markoulakis
Wilfrid Laurier University

D. Murray
Wilfrid Laurier University

Pam Bryden Dr.
Wilfrid Laurier University, pbryden@wlu.ca

Heidi Ahonen-Eerikäinen
Wilfrid Laurier University

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PHYSIOACOUSTIC THERAPY: PLACEBO EFFECT ON RECOVERY FROM EXERCISE-INDUCED MUSCLE DAMAGE

P. M. Tiidus[1], R. Markoulakis[1], D. Murray[1], P. J. Bryden[1], H. Ahonen-Eerikäinen[2]

[1] Department of Kinesiology & Physical Education
[2] Department of Music Therapy, Wilfrid Laurier University,
Waterloo ON, Canada

ABSTRACT

We evaluated claims that physioacoustic therapy can enhance muscle healing following damaging exercise. Untrained subjects were randomly assigned to control (C), placebo (P) or treatment (T) groups. All groups performed 70 eccentric triceps contractions followed by; no treatment (C), sham physioacoustic treatment (P), or actual physio-acoustic therapy (T) on days 1–4 post-exercise. Muscle soreness and isometric and concentric triceps peak torque were determined pre-exercise and on days 1–4 and 7 post-exercise. The T group received physioacoustic therapy for 30 min/day on the treatment days. The P group believed they received physioacoustic therapy, although the chairs were turned off. Peak torques were depressed ($P < 0.05$) on days 1–3 in all groups and returned to pre-exercise values by days 4–7 in both P and T groups. C group peak torques remained depressed ($P < 0.05$) through day 7. Soreness was elevated ($P < 0.05$) in all groups on days 1–2 post-exercise. P and T groups reported no soreness by day 3 while the C group remained sore ($P < 0.05$) through days 3–4. The T group recovered soreness and force faster than C but at a similar rate to the P group. The effectiveness of physioacoustic therapy in enhancing post-exercise muscle healing may be attributable to a placebo effect.

Key words: muscle soreness, physioacoustic therapy, placebo effect, muscle damage

INTRODUCTION

Various forms of sound induced vibration have been developed over the past several decades primarily as potential therapeutic or relaxation inducing modalities [12, 18]. Mostly through the work of Scandinavian therapists music or low frequency sound induced vibration has been used as a relaxation or a "therapeutic" modality with physically or mentally handicapped children, deaf individuals or those with brain injuries, chronic pain, anxiety or other disorders [10, 24].

A specific "physioacoustic" method and chair were developed in Finland in the late 1980's to treat handicapped and brain injured individuals, however anecdotal information soon emerged suggesting other possible uses in treating muscle tension, pain sensation, high blood pressure and other clinical conditions [9, 12].

The reclining physioacoustic chair (Next Wave UK Ltd, Finland) is fitted with six audible speakers and a transformer, that controlled by a computer, generate low frequency (27–113 Hz) sinusoidal sound waves. These waves can be pulsed and/or varied by direction (from top to bottom of the body or vise-versa) or scanned to try to match theoretical "resonance frequencies" of muscles [12]. Butler [3] has suggested that physioacoustic induced vibration differs from mechanical vibration in that: 1. mechanical vibration causes numbness while physioacoustic vibration does not, 2. mechanical vibration causes muscle contraction while physioacoustic vibration induces muscle relaxation, 3. mechanical vibration induces muscle fatigue and has only passing effects on dampening muscle pain while physioacoustic vibration does not induce muscle fatigue and has longer lasting analgesic effects.

Physioacoustic treatment is currently practiced in numerous countries primarily in northern Europe and in parts of North America for multiple therapeutic purposes including sports medicine and promotion of muscle healing [9]. According to case studies and practitioner experiences, physioacoustic treatment may help relieve pain and reduce the length of the rehabilitation period when treating sports injuries, including acute muscular trauma and overuse injury [18, 19]. The physioacoustic method has been approved by the United

States Food and Drug Administration as a class II (low risk, non-invasive) device and allowed three claims: improvement of circulation, release of muscle tension and alleviation of minor pain [12]. There is anecdotal information that the physioacoustic device has also been used by a number of European football and hockey teams as well as by other athletes such as skiers and ski jumpers as a means of recovery/ regeneration following intense physical activity. Its use, while still regional, is growing in popularity.

Despite the claims of efficacy and its use by athletic populations as a means to enhance muscle recovery, there is almost no experimental data currently available to verify the alleged benefits of physioacoustic therapy. In addition, there is currently no plausible physiological theory as to how physioacoustic therapy may be able to accelerate muscle healing, repair or recovery. Burke and Thomas [2] found some evidence of pain reduction due to physioacoustic therapy in conjunction with physiotherapy in patients with total knee replacement. Burke [1] also reported positive effects of physioacoustic therapy on pain management in post-operative gynecological patients. Pain reduction, relaxation and improved mood have also been reported with the use of physioacoustic therapy and sound/music therapy in various other clinical and post-operative patients [3, 12, 17]. However no studies have looked directly at any possible benefits of physioacoustic therapy on recovery of muscle following damaging exercise or overtraining.

This is the first study which has attempted to determine if physioacoustic therapy would have any effect on muscle recovery or soreness sensation following eccentric exercise induced muscle damage. The eccentric exercise-induced muscle damage and recovery model and its time-course has been well described in the literature and is similar to the muscle disruption seen in over-trained athletes or individuals who have performed unaccustomed exercise [4, 5, 6]. The eccentric exercise-induced muscle damage model has also been previously used to assess the effectiveness of other therapeutic modalities such as massage and ultrasound on muscle recovery [15, 21]. It was hypothesized that physioacoustic therapy would significantly enhance the rate of recovery of indices of muscle damage and soreness sensation following eccentric muscle exercise relative to control and placebo treatment groups.

METHODS

The study was approved by the Wilfrid Laurier University Human Research Ethics Board. All subjects signed informed consent prior to participation in the study.

Subjects: Thirty one (7 male and 24 female) university students, age 20.7±3.1 y, weight 69.1±10.7 kg completed the study. All subjects were healthy, with no physical impairments. None of the subjects had participated in any systematic upper body training in the past 4 months or had any upper limb injuries.

Procedures: Subjects were randomly divided into 3 groups: a physioacoustic treatment group (T) n = 12, a placebo treatment group (P) n = 12 and a control-no treatment group (C) n = 7. Because of problems in experimental logistics, data from several of the C group subjects was not complete, hence the uneven number of subjects in the groups.

All subjects received two brief familiarization sessions on the CYBEX NORM apparatus prior to the data collection in order to become accustomed to generating maximum isokinetic and isometric triceps muscle contractions. The T and P groups were also exposed for brief periods to the physioacoustic chair on two occasions prior to the start of the experiment. In the case of the T group, the physioacoustic chairs produced a range of acoustic vibrations to acclimate them to the vibrations. The placebo group was also exposed to the physioacoustic chairs for the same time periods with the chair turned off.

In order to induce muscle damage and soreness similar to that seen with athletic overtraining or following unaccustomed exercise, all subjects performed 7 sets of 10 maximum effort eccentric isokinetic (60°/sec) triceps contractions using the CYBEX NORM [6]. Subjects were given 1 minute rest between sets and warmed up with 10 submaximum contractions prior to initiating the maximum effort sets. All subjects were verbally encouraged to maintain maximum efforts.

On days 1, 2, 3, 4 following the eccentric triceps contraction protocol, the T group received 30 min physioacoustic treatments designed by Marco Kärkkäinen, an experienced physioacoustic therapist from Finland, specifically to treat exercise-induced muscle damage. An outline of physioacoustic treatment protocol is depicted in Table 1. The P group was also exposed to the physioacoustic chairs for 30 min on the same days as the T group. However, the chairs were turned off and the subjects were lead to believe that the treatment was occurring. The C group were not exposed to physioacoustic chairs.

Table 1. Physioacoustic therapy, treatment protocol

Day	Treatment type	Main Frequency (Hz)	Duration (min)
1	Acoustic Massage	40	30
2	Acoustic Relaxation	50	30
3	Acoustic Relaxation	50	30
4	Acoustic Relaxation	60	30

Outcome measures: Prior to and on days 1, 2, 3, 4 & 7 following the eccentric triceps contraction protocol, all subjects were also evaluated for isometric and eccentric isokinetic (60°/sec) triceps peak torques and for muscle soreness sensation. Subjects were asked to perform isometric and eccentric triceps contractions using the CYBEX NORM. Three trials with 30–60 sec rest between trials for each of the isometric and eccentric contractions were performed with the best of the three trials recorded. Each subject's baseline peak torque (as determined prior to the eccentric exercise protocol) was set as 100% with subsequent force loss and recovery calculated as a percentage of the baseline. Muscle force (peak torque) measures are reliable non-invasive gross indicators of muscle damage and repair as muscle force is typically lost following damaging exercise and slowly recovers over several days as muscle recovers [5, 23].

Muscle soreness was evaluated by asking subjects to rate their triceps muscle soreness while performing light contractions on a scale of 1–10 with 1 representing "not sore at all" and 10 representing "extremely sore" [14, 20]. Muscle soreness is also a quantifiable indicator of physiological responses to muscle damage and its time-course has been well described in the literature [6]. All measures were made immediately prior to the daily physioacoustic treatment or placebo treatments (T and P groups) and at the same time as the measures for the C group.

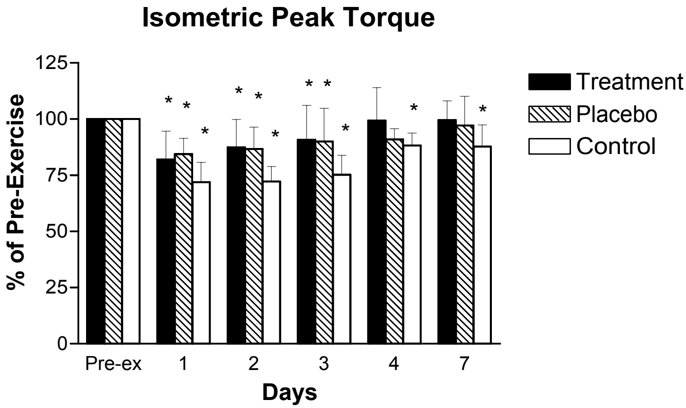
Statistical Analysis: Data was analyzed using SPSS statistical package. Analysis of Variance (ANOVA) as pairwise comparisons at each time point (within groups) was performed. Significance was set at $P < 0.05$.

RESULTS

The results for post-eccentric exercise triceps isometric and eccentric isokinetic peak torque measures are depicted in Figure 1a and 1b respectively. For normalization, the data are expressed as a percentage of pre-exercise peak torques, however measures were made and statistics performed on the data as expressed in Newton metres (Nm) per kg body weight. Isometric and eccentric triceps muscle peak torque was significantly ($P < 0.05$) reduced relative to the pre-eccentric exercise protocol in all groups on days 1 and 2 post-exercise. By day 3 or 4 and afterward both the T and P group triceps isometric (day 4) and eccentric (day 3) peak torques were no longer significantly different ($P > 0.05$) from pre-exercise values suggesting that triceps muscle force had essentially recovered by day around day 3–4 in these groups. Interestingly both the isometric and eccentric peak torques for the C group were still significantly depressed relative to pre-exercise baseline at day 7 post-exercise, suggesting that full muscle force recovery for the C group had not yet occurred.

The results for muscle soreness sensation are depicted in Figure 2. All groups experienced significantly ($P < 0.05$) elevated muscle soreness on days 1 and 2 post exercise. While the T and P groups soreness levels were no longer significantly different ($P > 0.05$) from pre-exercise values by day 3 and subsequent days, the C groups continued to experience significantly elevated ($P < 0.05$) soreness levels on days 3 and 4 post-exercise and did not return to pre-exercise levels ($P > 0.05$) until day 7 post-exercise.

A



B

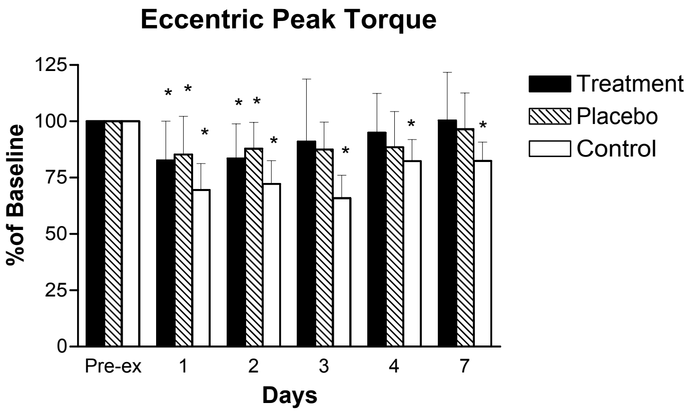


Figure 1. Triceps muscle isometric (a) and eccentric isokinetic-60˚/sec (b) peak torques prior to and up to 7 days post-eccentric exercise as a percent of pre-exercise peak torque for physioacoustic treatment, placebo treatment and control (no treatment) groups. Data expressed at mean ± SD.

*Significant difference between group at this time point and its pre-exercise value ($P < 0.05$).

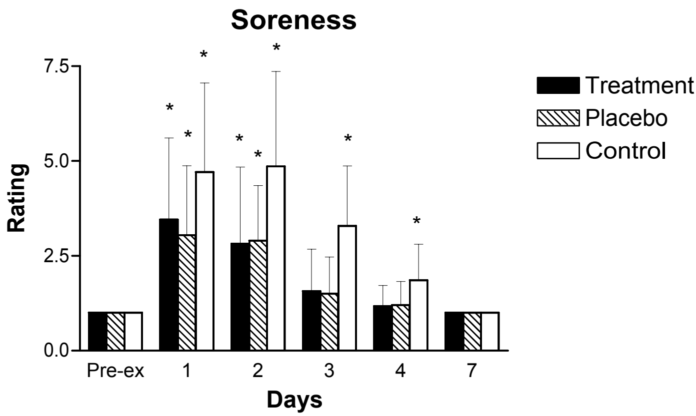


Figure 2. Triceps muscle soreness prior to and up to 7 days post-eccentric exercise for physioacoustic treatment, placebo treatment and control (no treatment) groups. Data expressed at mean ± SD.

*Significant difference between group at this time point and its pre-exercise value ($P < 0.05$).

DISCUSSION

This is the first controlled study to examine the potential of physio-acoustic therapy to influence indices of muscle damage and recovery following eccentric muscle contractions. As expected, all experimental groups experienced significant decreases in both isometric and eccentric triceps peak torque and increased muscle soreness following eccentrically induced muscle damage. Muscle strength loss and regain is a commonly recognized as being quantitatively reflective of the degree of muscle damage and recovery [23] and has been previously used in evaluation of the effectiveness of other therapeutic modalities affecting muscle repair [15, 21]. Changes in muscle force consequent to damage are reflective both of muscle structural damage and muscle excitation-contraction uncoupling [16, 22]. Muscle soreness is also commonly assessed as an indirect indicator of muscle disruption [23] and while not necessarily directly related to rate of muscle force recovery [23] may reflect muscle inflammatory processes associated with muscle damage [13].

Contrary to our hypothesis, both the physioacoustic treatment (T) and the placebo treatment (P) returned to pre-exercise muscle force and muscle soreness levels significantly sooner following eccentric muscle contractions than the untreated control (C) group and at times that were not different from each other. These results suggest that physioacoustic treatment appeared to enhance the rate of recovery of indices of muscle damage relative to no treatment. However, since the placebo treatment group also experienced a similarly enhanced rate of recovery, the effects of the physioacoustic treatment cannot be attributed to any physiological effects on muscle repair mechanisms or soreness sensation and must instead be attributed to placebo effect alone. Physioacoustic therapy is not unique in this respect as other studies have also found that the placebo effect may contribute to some or all of the alleged therapeutic benefits of various other complementary medicine therapies [11].

The placebo effect has been extensively documented as having significant analgesic influence and on markedly enhancing recovery from various forms of injury and disease [7]. Hence placebo groups are commonly included and indeed required in studies examining the potential of various therapeutic interventions. However, to demonstrate the specific physiological effectiveness of any drug, mainstream medical treatment or complementary medical therapy, the effects of the treatment must be clearly demonstrated to exceed that of any potential placebo effect alone [8]. In this regard, this study was unable to demonstrate any specific benefit of physioacoustic therapy beyond that which could be explained by placebo effect. Hence, based on these results, physioacoustic therapy cannot yet be recommended as a modality to enhance muscle physical or performance recovery in athletes or in individuals who have experienced over-use injury.

As this was the first study to examine the potential of physioacoustic therapy in affecting recovery from muscle damage, more extensive research using different models, clinical conditions and physioacoustic treatment paradigms still needs to be performed to fully explore the potential for physioacoustic therapy in treating muscle damage and in influencing recovery from over-training or over-work related muscle performance decrements.

In conclusion, physioacoustic therapy failed to enhance indices of muscle recovery following eccentric contraction induced damage beyond that seen with placebo treatment. More extensive research with a wider variety of treatment and injury paradigms is needed to fully document the potential (or lack there of), of physioacoustic treatment in athletic or other therapeutic settings.

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Correspondence to:
Peter M. Tiidus
Department of Kinesiology & Physical Education
Wilfrid Laurier University
Waterloo ON
Canada