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Expectancy reduces symptoms but not functional impairment following exercise induced musculoskeletal injury

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Abstract

Objectives—To quantify the extent to which the participant-provider interaction influences the response to sham treatment following exercised-induced acute musculoskeletal pain.

Methods—Forty participants between the ages of 18 and 35 volunteered for the study. Participants came to the laboratory for three test sessions 48-hours apart (Day 1, 3 and 5). During the initial session, baseline measures were assessed and participants underwent a fatigue protocol for the biceps brachii. Participants were then assigned to a positive expectation or a no-expectation condition before receiving a sham laser therapy treatment. The positive expectation group received symptom improvement priming prior to their sham treatment. Participants allocated to the no-expectation condition received no feedback prior to the sham treatment. Maximum voluntary isometric contraction (MVIC); relaxed elbow angle (RANG); visual analogue scale (VAS); and the QuickDash (QD) questionnaire were used as outcome measures.

Results—The positive expectation group had a significant reduction in perceived pain compared to the no-expectation group at day 3 follow-up, with the mean scores being 34.65mm (SE=4.44) compared to 49.4mm (SE=5.79) respectively. There were no between-group differences with respect to MVIC, QD or RANG outcomes. In addition, there were no significant between-group differences observed with expected pain on follow-up visits, the effect sizes were $d=0.26$ on day 1 for day 3 and $d=0.51$ on day 3 for day 5.

Discussion—Positive expectations before a sham treatment enhanced reduction in pain intensity but did not improve functional impairments following exercise induced acute musculoskeletal injury.

Keywords

Placebo; Acute Pain; Expectancy; Musculoskeletal Injury

INTRODUCTION

The placebo effect is a widespread phenomenon in clinical practice and research. Beecher first reported that the placebo effect is prevalent in 35% of clinical cases and therefore, should be accounted for in clinical trials (1). Placebo effect has since been included into the 'gold standard' for scientific studies which is now known as the double-blind randomized controlled trial. The theory behind the placebo effect was to include a treatment group that did not receive an active treatment or therapy, which allowed scientists the ability to judge the true effect of the active intervention being studied. The magnitude of the placebo effect can be observed in many allied health care disciplines including nursing, physical therapy, and athletic training. In some cases, the placebo effect is seen to override pharmacological effects. Levine and Gordon (2) suggested that the placebo effect can be just as strong as a hidden injection of morphine. Schachter and Singer (3) were able to demonstrate that the effects of epinephrine were reduced when subjects were misinformed as to the action of the drug. Understanding the mechanism of the placebo response is essential for all medical practitioners, particularly those dealing with patients suffering from conditions that have reported to be most influenced by the placebo effect such as chronic pain, depression, and impaired motor function (4). However, there seems to be a current lack of literature on the placebo response and its effect on acute musculoskeletal pain.

The management of musculoskeletal pain and dysfunction after acute injury varies widely among health care providers. Ekman and Koman (4) suggest that acute musculoskeletal pain is often undertreated even though practitioners should be adept at addressing acute pain associated with a variety of musculoskeletal conditions, including ankle sprains, back pain and other outpatient procedures. Unfortunately, inadequately treated acute pain can result in sensitization of the peripheral and central nervous system leading to the development of chronic pain (5, 6). Treatment of acute pain may include the use of therapeutic modalities such as cryotherapy, electrotherapy, massage and/or phototherapy. Much attention and scientific inquiry has been directed toward the benefits of these therapeutic modalities, while very little attention has been given to the value of the participant-provider interaction as a stand-alone therapeutic 'modality' for pain relief and recovery (7). The rationale for providing positive expectations of pain relief and recovery by the provider in conjunction with a therapeutic treatment is rooted in the notion that such information can lead to a better clinical outcomes (8). The psychosocial influence of increasing positive expectations can cause a lessening of fear, stress and anxiety in the patient (9), as well as an increase in self-esteem and improved coping (10). Stress and anxiety are known entities that may adversely affect the body and increase the patient's focus on symptoms (9). Therefore, reduction of stress, fear and anxiety may subsequently reduce the severity of physical symptoms and impairment and facilitate recovery.

Placebo interventions have been studied using the concepts of two theories: expectancy (11) and/or conditioning (12–14). Expectancy as a placebo intervention is related to a patient's expectation of improvement, which is directly linked to physiological reactions in the body that improve functional recovery and lessen the symptomatic response (9, 15, 16). Finnis and Benedetti (17) reported that the use of appropriate words activate centrally located pathways for endogenous opioids or dopamine systems, in turn, decreasing pain.

Conditioning relates to the patient's exposure to the provider and treatment being provided (13). Because of these exposure(s) with the provider and treatment, the patient will associate the provider and treatment with healing and recovery (13, 14). Klinger et al. (12) suggested that the placebo effect is mediated by instruction as well as by conditioning. Expectancy is a conscious process communicated to the patient (18) while conditioning is a learned response and occurs at the subconscious level (13, 14). Kirsch (19) suggests that the effects of conditioning are mediated by expectancy, but both mechanisms when used together illicit a greater placebo response than by one mechanism alone. Expectancy is associated with both a greater magnitude of placebo-related hypo-algesia (8, 20, 21) and clinical outcomes in patients presenting with musculoskeletal pain (22, 23). In contrast, Bialosky et al. (24) has shown that enhanced expectations can improve a person's satisfaction with an intervention even though the clinical outcomes were not significantly different from other groups in the study. Smeets et al. (25) observed similar findings on low back pain which demonstrated that higher expectations of recovery prior to an active therapeutic intervention (pretreatment) resulted in participants experiencing a greater perceived effect of the intervention, which reduced their low back pain. Smeets et al. (25) further suggests that future studies should examine therapeutic pretreatments, specifically the inclusion of an explanation of the therapeutic effects (e.g. expectancy) prior to a treatment. Previous research has evaluated how placebo expectancy can improve a symptomatic response, (26, 27) However there is little research measuring the influence of the placebo effect on pain and function after musculoskeletal injury.

The primary objective of this study was to determine how an instructional set affects responses to a sham treatment following exercise-induced musculoskeletal injury. We were able to achieve this by controlling how expectations were set during the participant-provider interaction prior to a sham treatment. We hypothesized that individuals that were part of the positive expectancy interaction would have greater symptomatic response and functional recovery.

MATERIALS & METHODS

The Institutional Review Board of the University of Florida approved this study. A total of 40 (29 females and 11 males) individuals volunteered to participate in the study (Table 1). Volunteers responded to posted advertisements via e-mail, and a research assistant followed up the e-mails with a series of questions to screen the individual for eligibility requirements. Volunteers were excluded from participation if they reported involvement in regular (2–3 times a week) resistance training exercise (e.g. weight lifting) or had suffered any injury to the upper extremity (shoulder/arm/wrist/hand) in the past six months that would prevent them from performing the resistance exercise protocol. Volunteers were also excluded if they reported taking nutritional supplements or anti-inflammatory medication on a daily basis.

We used a double-blind, randomized, two-arm experimental design to investigate the effects of controlling expectation in combination with a placebo intervention on symptomatic response and functional recovery following exercise-induced arm pain and dysfunction. Participants completed a 5-day trial that involved 3 laboratory visits, including the baseline

assessment, resistance exercise protocol, placebo administration coupled with sham therapeutic treatment and 2 follow-up appointments (Table 2).

During the first visit (day 1) participants read and signed an informed consent and completed a brief health screen (height, weight, blood pressure). Participants were then randomly assigned to a positive expectancy group (PE) (n=20) or a no expectancy group (NE) (n=20). Participants completed a series of pre-exercise measurements prior to completing a high intensity resistance exercise protocol. The resistance exercise protocol was designed to induce muscle damage characterized by a delayed onset of muscle soreness (DOMS), stiffness and functional impairment. A sham treatment using a therapeutic laser was administered to both groups following the exercise protocol. The provider gave participants in the PE group the following information verbally prior to receiving the sham treatment on day 1 (baseline) and day 3 (48-hrs post-injury): “Hello, I have extensive experience with using the therapeutic laser and you can expect the treatment to significantly decrease your pain level and speed your recovery”. The provider also answered any questions the participant had concerning the treatment. The provider gave participants in the NE group the following information verbally prior to receiving the sham treatment: “You will undergo a therapeutic treatment for your impairment and since this is a scientific study I will not be able to speak with you during the treatment”. In each condition, the same provider administered the placebo intervention and sham therapy to participants.

After the intervention we administered our expectancy manipulation check, which was assessed by having all participants use a 100 mm visual analogue scale (VAS) to predict how much pain they expected to experience in their biceps muscle on their ensuing follow-up visit. This was completed at the end of Day 1 to predict pain for Day 3, and again at the completion of Day 3 to predict pain for Day 5.

Follow-up assessments were performed on day 3 (48-hr post-injury) and day 5 (96-hr post-injury). Pre-injury and post-injury measures included self-report rating of muscle pain using a VAS, elbow range of motion, biceps muscle strength and a self-report questionnaire for symptoms and disability of the upper extremity. Participants were unaware that the phototherapy (laser) treatment was a sham.

Blinding

The provider administering the placebo intervention and laser treatment was separate from the individual who completed the clinical measures. The participants and examiner were blinded to group assignment. The provider was aware of group assignment, but was blinded to outcome measures.

Informed Consent and Debriefing

All participants were required to sign the informed consent; however, the consent disclosure omitted or altered certain descriptors of the study’s scientific purpose and design. For the purpose of consent, the title of the study was altered to read “The effects of laser therapy on exercise-induced muscle pain and soreness”. In the consent document, participants were informed that the trial was a study of the effectiveness of laser therapy for exercise-induced muscle soreness. Therefore, they were unaware of the study’s primary objective. The

omissions and alterations to the nature or purpose of the study were necessary to prevent the participants from knowing the actual objective of the study. Knowledge of the true objective would likely have negatively affected the outcomes of the study. The deceptive practices posed no harm to the participants.

After completing the project, each participant was debriefed by the examiner and given the opportunity to rescind their initial consent once the true purpose of the experiment was revealed. A debriefing form was then read and signed by the participant indicating whether or not they allowed their data to be used. No participants withdrew from the study and all of the participants consented to the use of their data after the debriefing was completed.

Fatigue Protocol

Muscle damage was induced using high intensity resistance exercise. An isokinetic testing and exercise device (Kin-Com 125 AP, Isokinetic International, Chattanooga, TN) provided resistance for the exercising muscle group (biceps brachii). Prior to starting the exercise protocol, each participant performed a series of stretching exercises involving all of the major muscle groups of the upper extremity. Participants were then seated in the isokinetic testing device with their dominant arm secured at their side in 90° elbow flexion. The participants' maximum voluntary isometric contraction (MVIC) was measured prior to completion of the exercise protocol consisting of repeated concentric and eccentric (lengthening) contractions of the biceps brachii. The angular velocity was set at 45°/sec for concentric actions and 60°/sec for eccentric actions. Each participant was instructed to perform the repetitions "as hard as they can", while the examiner provided verbal encouragement throughout the exercise protocol. Participants completed 3 sets of 20 repetitions separated by 1 minute of recovery followed-up with a post-exercise MVIC measurement. The protocol was considered complete if the follow-up MVIC was less than 50% of the participant's initial MVIC. If the post-exercise MVIC was higher than 50%, additional sets of 20 repetitions were completed until the aforementioned criteria was met.

Sham Treatment

A sham laser treatment was administered to the affected muscle following exercise/placebo intervention using a "dummy" laser diode. The sham laser treatment was performed in identical fashion to an active treatment, except that the output power of the laser was disabled. The participant was then instructed to lay supine and was given proper eye protection. The examiner then proceeded to mimic a true laser therapy treatment by scanning the diode over top of the affected area (biceps brachii). Treatment time was 5 minutes.

Measures

Self-reported Pain—A visual analog scale (VAS) was used to rate the amount of bicep's muscle pain. The VAS contains a line from 0–10 cm with 0 representing "no pain" and 10 representing "extreme pain". Participants were asked to draw a single dash through the line at the location that most ideally represents their level of pain.

Range of Motion (ROM)—Relaxed elbow angle (RANG) was used to quantify limitations in elbow range of motion as a result of the induced injury. The RANG was

measured using a standard two-arm plastic goniometer by having the participants stand with their dominant arm relaxed in a supinated position at their side. The RANG was measured in degrees (°).

Strength—Strength of the biceps brachii muscle was assessed using a maximal voluntary isometric contraction (MVIC). MVIC is the maximum voluntary force produced during an isometric muscle contraction. Participants were seated in the Kin-Com with their dominant arm placed at their side in 90° elbow flexion. Each participant performed three MVICs of the dominant arm. Isometric force was applied to the transducer for 5 seconds. A 30 second recovery period was provided between contractions. The most forceful contraction of the three trials was recorded as peak force in Newtons (N).

Self-reported Upper Extremity Disability—The QuickDASH (Disability of the Arm, Shoulder, and Hand) questionnaire was used to assess self-reported symptoms and disability (28). The QuickDASH focuses on the participant's ability to use the affected arm during activities of daily living. Participants rated their symptoms and ability to perform specific tasks using a 5-pt hierarchical Likert scale. Scores were obtained by summing circled responses, dividing the total by the number of items answered, subtracting 1, and then multiplying that figure by 25. A score of zero represents no symptoms or disability, while higher scores represent a higher level of symptoms and disability, with 100 being the highest possible score. A minimum of ten questions must be answered to score the QuickDASH.

Statistical Analysis

All statistical procedures were performed with PASW Statistics 18.0 statistical package (IBM SPSS Inc., Armonk, NY, USA). A 2 (condition) by 3 (time) ANOVA with repeated measures on the second factor was performed for all outcome measures to identify any significant differences between groups over time. Tukey's post-hoc testing was administered in the presence of an interaction effect. Statistical significance was set at $p < 0.05$. Bivariate Pearson correlation coefficients were performed to assess the level of associations between each dependent variable.

RESULTS

Expectation Manipulation Check

The PE group did have lower VAS scores than the NE group for expected pain for Day 3 and Day 5 but they did not achieve statistical significance at the 0.05 level. Further investigation by calculating effect sizes demonstrated that changes in expectation were in the appropriate direction and corresponded with a moderate change. Expectation differences for Day 3 for the PE group was 46.15mm (SD=22.49) vs. NE group 51.8mm (SD=20.75mm), $d=0.26$ and expectation difference for Day 5 was PE group 22.2mm (SD=20.26mm) vs. NE group 32.3mm (SD=19.32mm), $d=0.51$.

Self-reported Pain

There was a significant between-group difference observed in self-reported pain ($F_{(1,38)}=4.5$, $p=0.041$, $\eta^2=0.106$). The PE group perceived less pain in their biceps muscle when

compared to the NE group at 48-hr post-injury [($p < 0.05$), 34.65mm (SE=4.44mm) vs. group 49.4mm (SE=5.79mm)] respectively. There was no significant between-group difference at baseline [PE group 2.1mm (SE=0.35mm) vs. NE group 2.1mm (SE=0.39mm), $p > 0.05$], and pain ratings returned to near baseline levels after day 3, therefore no significant between-group differences on day 5 [PE group 7.1mm (SE=2.44mm) vs. NE 12.8mm (SE=1.41mm), $p > 0.05$] (Figure 1).

Range of Motion

There were no between-group mean differences ($p's > 0.05$) observed for range of motion at baseline [PE group 12.65° (SE=0.97°) vs. NE group 13.55° (SE=0.92°)], Day 3 [PE group 16.95° (SE=1.16°) vs. NE group 19° (SE=1.4°)], or Day 5 [PE group 12.75° (SE=1.03°) vs. NE group 15.35° (SE=1.21°)] ($F_{(1,38)} = 1.98$, $p = 0.17$, $\eta^2 = 0.05$) (Figure 2).

Strength

Between-group differences for strength were not different ($p's > 0.05$) throughout the length of the study ($F_{(1,38)} = 0.21$; $p = 0.89$, $\eta^2 = 0.001$). At baseline, the means of both groups were similar [Group PE 36.2N (SE=3.54N) vs. Group NE 37.25N (SE=3.88N)]. The mean force dropped for both groups on Day 3 [Group PE 34.65N (SE=3.57N) vs. Group NE 33N (SE=3.99N)], and by Day 5 returned to near baseline levels for both groups [PE 35.85N (SD=3.99N) and NE 34.2N (SE=3.87N)] (Figure 3).

Self-reported Disability

There were no between-group mean differences ($p's > 0.05$) observed for QuickDASH scores at baseline [PE group 4.7 (SE=1) vs. NE group 3.1 (SE=0.95)], Day 3 [PE group 12.3 (SE=3.11) vs. NE 17.9 (SE=3.47)], or Day 5 [PE group 7.4 (SE=1.51) vs. NE group 6.4 (SE=1.41)] ($F_{(1,38)} = 0.23$; $p = 0.64$, $\eta^2 = 0.01$) (Figure 4).

Bi-variate Correlations

We observed moderate to large negative correlations ($r = -0.30$ to $r = -0.60$) between strength (MVIC) and disability (QD) throughout post-injury recovery for both groups (Table 3). These significant correlations indicated that as upper extremity disability diminished over time of recovery strength levels were improving. All other bivariate correlations were below $r = 0.30$.

DISCUSSION

Our results indicated that expectancy reduces the symptomatic response after acute musculoskeletal injury, but not functional and disability outcomes. Our main finding was that the group receiving positive expectation priming with a sham laser treatment perceived less muscular pain 48 hours after injury when compared to the group that received no expectations. This is potentially clinically important because it demonstrates that positive expectations, when delivered prior to even an inert therapeutic modality treatment, can improve a participant's symptomatic recovery. This finding is consistent with other studies that have investigated expectancy for hypo-algesia with chronic pain and indicates that the brain may have a similar response to mediate acute musculoskeletal pain (29–34). A strength

of this study was the injury model, which allowed us to examine expectancy from the controlled onset of an acute musculoskeletal injury until recovery as both groups returned close to baseline levels by day 5.

We can partially explain this response by reviewing recent studies that examine brain imaging in association with expectancies. The rostral anterior cingulate cortex (rACC) is known to be a region of the brain that has an abundance of opioid receptors and has an important region in opioid analgesia and other forms of pain modulation (30). Petrovic et al. (30) used positron emission tomography (PET) to scan the brain and observed that the rACC became much more active with placebo responders compared to non-responders. Petrovic et al. (26) also was able to show that the rACC became more active while modulating pain. Bingel et al. and Kong et al (30, 31, 33) have noted that giving participants expectancies before applying a sham intervention activates the rACC on an fMRI, in contrast to a 'pain only' condition, where the rACC was not involved. These studies corroborate the findings of Wager et al. (32) who examined areas of the brain during the anticipatory period before a pain stimulus was applied. Results indicated a higher brain activity in the orbitofrontal cortex, dorsolateral prefrontal cortex, rACC and midbrain periaqueductal gray. This elevated brain activity in accordance with pain theories suggest that the brainstem opioid system may be under cognitive control from a higher cortical region, which would include the rACC (30). Kong et al. and Bingel et al. studies (29, 31) supported by the findings of de la Fuente-Fernandez et al. (33), which suggests that opioids are involved in expectancy-enhanced therapeutic intervention (33, 35). Our results support the theory that dopamine release can modulate pain, as our participants were able to decrease pain without any significant improvement in function at the site of the injury. These results are indicative that symptomatic relief improved independently from healing and functional recovery of the injured area. This could be useful clinically as it shows that expectations alone can differentially influence pain and symptom trajectories following acute musculoskeletal injuries.

The results of our functional and disability outcome measurements, (MVIC, RANG and the QuickDASH) did not show significant improvements in recovery following musculoskeletal injury. This agrees with the previously mentioned theory, that the hypo-analgesic response is modulated by the brain, thus it may not have a direct effect on functional recovery at the site of the injury (30–33). McCracken (36) showed that there was a low correlation between acceptance and pain intensity; which indicates that acceptance is not simply a function of having low levels of pain, instead it showed that acceptance of pain predicted better adjustment on all other measures of patient function. This could be a reason why function was not altered between groups, as both groups could have possibly accepted the pain and were able to continue with activities of daily living. Personal experience by the participants with exercise-induced muscular injury may also have influenced function.

Previous studies have shown that verbal suggestions similar to the one we used in our study can augment expectations (21, 37, 38). However, a notable limitation of this study is that we did not see a clear difference in expectations between the groups. The magnitude and direction of the expectation changes suggests a favorable response to the positive expectation instructional set, but statistical significance was not achieved. This could be

because we lacked power to see differences in expectation, even though differences were noted in one of the primary outcome measures. Another reason for lack of clear differences in expectation could be because the positive expectation set was only done once prior to treatment – a larger change could have resulted with additional priming. Furthermore, these were healthy individuals and it may be difficult to greatly change expectations for individuals not seeking healthcare for pain due to expectations already being fairly positive (e.g. ceiling effect). For example, as briefly mentioned while discussing the functional measurements, exercise-induced muscular injury is a common injury associated with different types of activities, such as eccentric exercise, performing new exercises, and resistance training (39). We postulate that if our participants have had a previous experience with exercise-induced muscular injury that they may have already developed positive expectations associated with the healing process, knowing that the pain associated with this injury typically self-resolves over the course of 5–10 days (39).

There are some other limitations to consider with this study. There may be a different placebo response to positive expectations between our experimental injury model and a true acute musculoskeletal injury like a ligament sprain or soft tissue contusion. This study used experimental pain, which we accomplished by using the resistance exercise protocol to induce microtrauma to the biceps brachii muscle. The purpose for using this model is that it allows for treatment at the most acute phase of an injury, which is immediately after the high intensity exercise. Musculoskeletal injury typically elicits pain and decreased function. We did not include a true control group in this study, which did not allow us to report on any between group differences compared to a ‘no treatment’ condition. However, because the purpose our study was to examine the influence of positive expectancy vs. no expectancy, we were able to account for one factor that could have attributed to improved healing.

Future studies should investigate blood biomarkers to see how expectancies elicit healing at the molecular and cellular level in acute musculoskeletal injuries. Implementing functional movement tests associated with the injured structure could give a better representation of the speed of healing. Observing these tests to see if improvement occurs after injury regardless if there is increased healing would be beneficial to see how far the effect of healing expectancies can extend. Repeating the study but administering follow-up testing at 24-hour intervals instead of 48-hour intervals would give us a more accurate representation of the effect of expectancy. Examining verbal expectation and the possible influence it may have on clinical and experimental pain would also be advantageous to future placebo studies. Adding in a conditioning component along with the positive expectation in a future study would be beneficial. Combining both mechanisms may yield larger pain relief or show an improvement in MVIC and ROM. By isolating expectancy from conditioning, we could also determine which placebo mechanism has the greatest impact on pain reduction. Lastly, it may also prove useful to use imaging such as fMRI to examine which regions of the brains are more active with expectancies associated with symptomatic relief before and after sham therapeutic treatment.

In conclusion, we were able to show that a positive expectation instructional set for a sham laser treatment following acute induced muscle injury provided better self-reported pain relief. However, in this sample, there was no difference in functional or disability outcomes

based on expectancy. Symptomatic pain relief during recovery from an acute musculoskeletal injury may be enhanced with positive expectations alone, but additional intervention may be needed to see differential gains in strength or disability outcomes.

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Figure 1.
Mean VAS Scores – compares mean VAS scores of expectancy vs non-expectancy groups on Day 1, Day 3, and Day 5, * indicates significant between-group difference observed on Day 3

Figure 2.
Mean RANG Scores – compares mean RANG scores of expectancy vs non-expectancy groups on Day 1, Day 3, and Day 5, no significant differences observed

Figure 3.
Mean MVIC Scores – compares mean MVIC scores of expectancy vs non-expectancy groups on Day 1, Day 3, and Day 5, no significant differences observed

Figure 4.

Mean QD Scores – compares mean QD scores of expectancy vs non-expectancy groups on Day 1, Day 3, and Day 5, no significant differences observed

Participant Demographics

Table 1

Group	Age(Years)	Sex	Height (m)	Weight (kg)	BMI (kg/m ²)
Positive Expectation (PE)	20.1±1.44	16 female 4 male	1.67±0.05m 1.78±0.04m	62.93±10.84kg 76.66±12.2kg	22.6±4.37kg/m ² 24.15±2.89kg/m ²
No Expectation (NE)	19.7±1.33	13 female 7 male	1.62±0.07m 1.81±0.07m	55.99±7.8kg 75.72±8.13kg	21.14±2.48kg/m ² 23.05±1.51kg/m ²

Table 2

Outcome Measures and Timeline for the Study Protocol

VISIT NUMBER Function Study Day	Visit 1 Baseline Day 1	Visit 2 48hrs Post-injury Day 3	Visit 3 96 hrs Post-injury Day 5
Informed consent/MHQ	X		
Group allocation	X		
Fatigue protocol	X		
Expectation instructional set	X	X	
Sham laser therapy	X	X	
VAS	X	X	X
ROM	X	X	X
MVIC	X	X	X
Self-report function	X	X	X

Table 3

Pearson Correlation Coefficients Between Strength (MVIC) and Disability (QD)

	QD Day 1	QD Day 3	QD Day 5
MVIC Day 1	-0.51	NS	NS
MVIC Day 3	-0.48	-0.33 [‡]	-0.34 [‡]
MVIC Day 5	-0.54	-0.38 [‡]	-0.32 [‡]

= p<0.01;

[‡]=p<0.05;

NS=not significant