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Effect of Swedish Massage on DOMS after Strenuous Exercise

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ABSTRACT

***International Journal of Exercise Science* 10(2): 258-265, 2017.** Delayed onset muscle soreness (DOMS) can occur after intense exercise and remain for several days. Massage is one means by which DOMS can be reduced; however, the timing of exercise, techniques applied, and timing of application produces differing outcomes. *Purpose:* To evaluate the effect of a 20-minute Swedish massage immediately after strenuous exercise on DOMS. *Procedures:* Twenty college students engaged in two sets of a squatting exercise to fatigue and then the right or the left leg was immediately massaged. Effleurage, petrissage, friction and compression manual techniques were used for 10 minutes on the quadriceps and the 10 minutes on the hamstrings and gluteal group, so that each manual technique utilized 2.5 minutes. Participants rated their DOMS 24 and 48 hours later with a single-digit incremental numeric rating scale. *Results:* Delayed onset muscle soreness in the massaged leg at 24 hours was significantly lower compared to the non-massaged leg (p = .019, Cohen's d = .56), but no significant difference at 48 hours existed between the legs (p = .097, Cohen's d = .49). Additionally, the increase in DOMS from 24 to 48 hours was significant in the massaged leg (p = .043, Cohen's d = .83), but a significant increase between these two time points was not evident in the non-massaged leg (p = .067, Cohen's d = .49). *Conclusions.* A 20-minute Swedish massage immediately after squatting exercise is effective in attenuating DOMS after 24 hours.

KEY WORDS: Muscle soreness, muscle pain, muscle rub

INTRODUCTION

Delayed onset muscle soreness (DOMS) is a phenomenon that can occur 12-72 hours after strenuous activities, most notably with activities involving eccentric contractions (23) and can be due to lactic acid, muscle spasms, connective tissue damage, muscle damage, inflammation, and enzyme efflux (1). Unfortunately, DOMS results in pain (13) and in decreased performance (19), thus much attention has been given to finding ways to alleviate it. For example, pain medications, specifically NSAIDS, had no effect on pain or function in some studies (9, 22) but lowers pain in others (25). Stretching does not seem to improve pain or function associated with

DOMS (10, 16) nor does ice water immersion (20). Some evidence exists that warming up may (14) or may not (10) be effective in reducing DOMS, and other studies indicate contrast water therapy reduces pain and aids in recovery of DOMS (12, 27), and again others do not (26). Other sources of therapy, such as ultrasound (4), electrical nerve stimulation (5), and laser therapy (3) have not been found to be effective in lowering DOMS.

A very promising means for reducing DOMS is massage therapy. Although there is some evidence to suggest massage aids in performance recovery during DOMS (17) the consensus is that it has no substantial effect after DOMS-inducing exercise (19). On the other hand, massage has been shown to reduce pain associated with DOMS with as little as a 10-minute application 2-3 hours after DOMS-inducing exercise (21, 31), after a 20- or 30-minute massage 2 hours after exercise (8, 11), and with as much as 4 days of daily massage (24). Many other findings support the effectiveness of massage on reducing DOMS-associated pain (7) but discrepancies still exist. For example, an 8-minute massage immediately and 24 hours after DOMS-inducing exercise did not lower soreness rating (28) nor did a 10-min massage immediately and 2 hours post exercise (15). The popularity for using massage as pain control, therefore, needs further exploration to support such claims. The purpose of this study was to explore the role of massage on DOMS after a bout of DOMS-inducing exercise. It was hypothesized DOMS would be significantly reduced 24 and 48 hours after a 20-minute massage immediately after exercise.

METHODS

Participants

This study was approved by the University's Institutional Review Board. A convenient sample of 20 college student volunteers (table 1) read and signed an informed consent prior to the start of the study. Inclusion criteria included any college student aged 18-40 years with no adverse health conditions. Participants were excluded if they had the following: pregnancy, current use of medication for pain control, and presence of any lower extremity condition or injury precluding exercise. All participants completed a physical activity readiness questionnaire prior to participating and were instructed to avoid strenuous exercise, particularly eccentric exercise, four days prior to the intervention. Participants were also asked not to consume caffeinated products during their involvement in the study. Finally, participants were asked to wear lose clothing in order to easily expose the sites to be massaged. The first participant to enter the study was assigned the right leg, the second the left leg, and alternating thereafter.

Table 1. Participant characteristics.

	Total (N=20)	Males (n=13)	Females (n=7)
Age	25.8±4.4	26.0±4.8	25.4±3.9
Height	169.7±11.4	167.0±8.5	174.7±14.9
Weight	79.7±22.0	75.4±16.0	87.6±30.1
BMI	26.9±5.0	27.7±4.4	25.3±5.9
Squats	238.1±217.9	234.7±251.9	244.5±152.7

Note: Values are means±sd. Age=yrs., height=cm, weight=kg, squats=total performed.

Protocol
Participants reported to the human performance laboratory where height and weight was measured using a Seca S-214 portable height rod (Hanover, MD) and a Detector DR400C digital body weight scale (Webb City, MO), respectively, before exercise.

Participants then performed two sets of a squatting exercise to fatigue while holding a 3.63 kg (8 lb.) dumbbell weight for men and a 2.27 kg (5 lb.) for women. The weight was held close to the chest and participants were instructed to lower their torso to a seated position then return upright at a cadence of one repetition approximately every two seconds. Once fatigued after the first set they were given one minute to rest and then performed a second set to fatigue but without the weight. If cadence slowed more than two seconds per repetition but they could still continue, they were allowed to do so. A hand tally was used by the investigator to count the repetitions.

After a brief rest to catch their breath (no more than three minutes), the participants dressed down to one layer of clothing and lay down (either supine or prone) on a standard massage table under the top sheet covering themselves. The investigator (a registered massage therapist) proceeded to drape a single leg with a diaper drape which revealed only the muscle group that received massage therapy. A quarter size dollop of Biotone massage lotion was used during massage and was reapplied if and when necessary. The investigator executed Swedish massage using effleurage, petrissage, friction, and compression manual techniques. The massage lasted 20 minutes; 10 minutes on the anterior muscles (quadriceps) and the 10 minutes on the posterior muscles (hamstrings and gluteal group), such that each manual technique utilized 2.5 minutes. There was no specific order to the technique or muscle group.

After the massage was performed, the participants dressed and were given a printed scale to measure their DOMS in both legs at 24 hours and 48 hours. This single-digit incremental numeric rating scale is commonly used to rate DOMS, with 0 indicating no pain and 10 indicating the worst possible pain. When rating DOMS, participants were asked to gently perform one body squat, bend the legs at the knee while keeping the hips straight in a standing position, and gently palpate the front and back of the legs. Participants were contacted by the investigator at 24 hours as a reminder to rate their DOMS, then turned in the scale at 48 hours at which time they rated their DOMS again.

Statistical Analysis
All analyses were performed using IBM SPSS Statistics 23.0 for Windows (IBM SPSS, Armonk, NY). A 2 (leg) X 2 (time) factorial ANOVA with repeated measures on the second factor was used to assess significant differences in DOMS between legs and within time, with alpha set at 0.05. The Sidak correction was used to control familywise error rate for multiple comparisons. Cohen's *d* effect size (ES) was calculated as ES = $(M_1 - M_2)/s_c$, and was used to estimate the the degree to which massage influenced DOMS. An ES of 0.8 or greater was considered large, 0.5 moderate, and 0.2 or less was small. Mean scores of DOMS at 24 hours was subtracted from 48 hours for the massaged and non-massaged legs, resulting in difference scores for each leg. A

paired *t*-test was then used to determine if the change in DOMS between legs at 24 to 48 hours was significant.

RESULTS

Results indicate significant differences ($F_{(3, 17)}$ = 6.69, p = .003) in the model, with pairwise comparisons specifying a significantly lower DOMS in the massaged leg at 24 hours compared to the non-massaged leg (p = .019, Cohen's d = .56). No significant difference was noted between the kegs, however, at 48 hours (p = .097, Cohen's d = .49). While DOMS was significantly elevated in the massaged leg from 24 to 48 hours (p = .043, Cohen's d = .83), this was not the case for the non-massaged leg (p = .067, Cohen's d = .49). The non-interactive effect of soreness ratings is illustrated in figure 1 and confidence intervals are displayed in table 2.

Figure 2 illustrates the difference scores from 24 to 48 hours between the massaged and non-massaged leg, which was not significantly different ($t_{(19)}$ = 0.18, p = .423, Cohen's d = .10).

DISCUSSION

These findings suggest massage is beneficial in lowering DOMS for the first 24 hours after an acute bout of squatting exercise. Not only was the finding significant, there was also a moderate effect size to support this finding. While no statistical difference was found between the massaged and non-massaged leg at 48 hours, the effect size was still moderate and average pain rating was still lower in the massaged leg. Other studies demonstrate DOMS continues to increase after 24 hours as well as the significant effects of massage on DOMS at 48 hours (11, 21, 24). While this study also demonstrated greater DOMS after 24 hours, the finding of a non-significant effect of the massage at 48 hours could have been due to

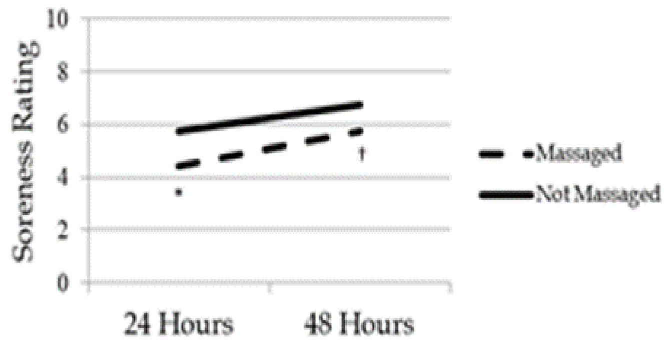

Figure 1. *Rating of soreness was significantly lower in massaged leg compared to non-massaged leg after 24 hours (p=.019). †Rating of soreness was significantly greater in the massaged leg after 48 hours compared to 24 hours (p=.043).

Table 2. Confidence intervals (95%) for difference in DOMS between condition and time.

	Upper	Lower
ML-NML at 24 hrs	-2.29	-0.15
ML-NML at 48 hrs	-2.17	0.12
24-48 hrs ML	-2.51	-0.03
24-48 hrs NML	-2.20	-0.05

Note: Values are based on a 0-10 rating scale. ML=massaged leg, NML=non-massaged leg.

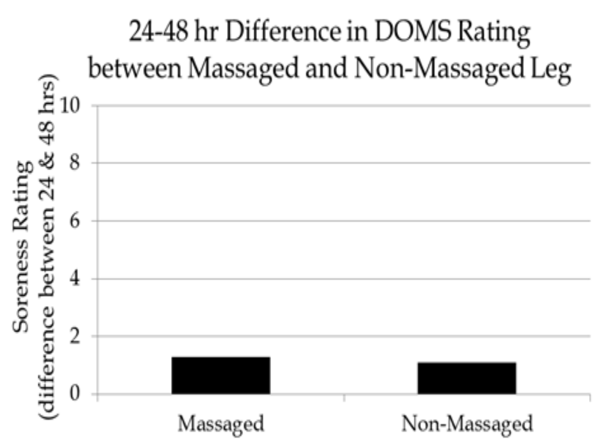

Figure 2. There was no significant difference in the difference scores of 24-48 hour soreness rating time points between the massaged and non-massaged leg (p>.05).

the type of exercise performed by the participants, the timing of the massage, and/or the type and intensity of the massage. In the current study, it is clearly evident that the exercise performed by the participants induced DOMS. Ratings were collected up to 48 hours, at which point DOMS was greatest, and had a 72-hour rating been assessed, it is possible they would have continued to rise. In any case, DOMS was greater after 24 hours, demonstrating the effect of the exercise to elicit soreness.

In the current study, it seems that massage had its greatest effect during the first 24 hours. This is indicated by the significant difference in DOMS between legs for the 24-hour rating but not the 48-hour rating, and is supported by the non-significant finding between the difference scores within each leg from 24 to 48 hours (figure 2). In other words, soreness did not decrease at a greater rate in either leg from 24 to 48 hours, suggesting the lower ratings in the massaged leg at 48 hours was due to the reduced ratings at 24 hours. Whereas this study applied massage immediately after exercise, other studies waited 2-3 hours before applying the massage (11, 8, 21, 31), which could be attributed, in part, to differences in findings.

The degree to which methodology and participant selection among studies differ in the literature is most likely the cause of inconsistent findings on DOMS ratings after massage (1). Some studies found no effect of an 8-10 minute massage on DOMS (15, 18) while others found a 10-minute massage to lower DOMS (31), thus suggesting a difference in another part of the methodology can be attributed to these conflicted findings. The current study employed a 20-minute massage, which resulted in similar DOMS rating patterns in other studies that performed massage in a similar time frame (11, 17). Despite differences in methodologies, it is generally accepted that massage can lower DOMS after a bout of high intensity exercise (7) and this study supports this conclusion.

The mechanisms by which massage affects DOMS have also been explored in an attempt to clarify how it works. Smith et al. (21) demonstrated lower serum creatine kinase levels in massaged participants, which was associated with elevated neutrophils and serum cortisol. The authors postulated that massage may have interfered with emigration of neutrophils from the circulation into the tissue spaces and/or that cortisol, a glucocorticoid with anti-inflammatory and analgesic properties, may have been elevated as a result of the body perceiving the massage as a stressor. In a review by Nelson (18), however, it is stated the effect of massage on cortisol levels is still unclear but that there is evidence serotonin and dopamine are released with massage. While creatine kinase has been found to be lower after massage in other studies (31), it is primarily a marker for muscle damage and may not be a good correlate with pain (2). Some have demonstrated increases in local circulation after massage (30) while others have shown massage does not seem to elevate arterial or venous mean blood velocity above resting levels (24), yet evidence does exist for massage’s role in reducing inflammation by attenuating production of inflammatory markers and activating signaling pathways for mitochondrial biogenesis (6). Still, the exact mechanism of how massage affects ratings of DOMS is unclear, as pain is viewed as psychological, can be tolerated differently by different people, and viewed differently among different people. These mechanistic findings are, in part, a means to explain massage's role on muscle function in a DOMS state, of which massage seems to have little to no effect (29).

As with all studies, this study poses limitations. For example, this study utilized a control leg for comparison, with this leg receiving no treatment at all. The psychological effect of the massage cannot be ruled out, as participants may have expected the touching and manipulation to have an effect. Since no treatment was provided for the control leg, pain ratings may have been influenced just by knowing one leg was treated and the other was not.

This study also utilized a numeric rating scale, which is considered a simple scale. This and other simple scales, such as visual analog and verbal, are rather one-dimensional and do not consider additional aspects of pain, such as sensory and emotion. Had a more complex scale been used, such as a differential descriptor scale, greater insight could have been provided to the effect of the massage. In any case, using a simple scale to measure intensity of pain is quite common and a very practical means to rate DOMS in a controlled study, clinical population, or athletic population.

While it is evident massage has a positive effect on DOMS, the mechanism of this action is unclear. Future studies should explore and report mechanistic findings to add to the literature. Other studies should also explore the timing, type, and duration of the massage for optimal benefits of DOMS relief.

In conclusion, this study demonstrates the effectiveness of a 20-minute massage on reducing 24-hour DOMS. Massage can be beneficial for individuals in such states as it may reduce discomfort in the muscle after a strenuous workout or activity. While performance may not be at the level prior to the DOMS state, massage may have a practical application in allowing an individual to better tolerate movement.

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