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SPORTS MASSAGE THERAPY ON THE REDUCTION OF DELAYED ONSET MUSCLE SORENESS OF THE QUADRICEPS FEMORIS

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ABSTRACT
Purpose. Massage therapy is one of most commonly applied treatments during athletic training. The aim of this study was to assess the effectiveness of sports massage therapy on reducing post-exercise quadriceps muscle soreness. **Methods.** A sample of 29 women aged 24–26 years was divided into an experimental group (n = 15) receiving classic sports massage therapy and a control group (n = 14) given no treatment. An exercise session consisting of five sets of deep squat jumps was administered after which lower limb power as assessed via the vertical jump test. Muscle soreness was assessed using the visual analogue scale (VAS) and exercise intensity with the Borg Rating of Perceived Exertion Scale. Subsequent measurements of lower limb power and muscle soreness were performed 24, 48, 72 and 96 h after the exercise session. Differences between the measurements were assessed by the Friedman and least significant difference tests while between-group comparisons involved the Mann–Whitney U test. **Results.** The largest decrease in lower limb power was observed between the first measurement after the exercise session and 24 h later ($p < 0.01$). The smallest decrease in power was observed in the massage group. The highest levels of muscle soreness were noted 24 h post-exercise in the massage group and 48 h post-exercise in the control group. The experimental group showed a decrease in muscle soreness in each subsequent measurement, with the results close to zero on the VAS 96 h post-exercise. **Conclusions.** Massage therapy quickened recovery and improved muscle efficiency post-exercise and may serve as an effective treatment of muscle soreness. The analgesic effect of massage suggests it should be widely applied in sport, physical therapy and rehabilitation.

Key words: massage, DOMS, quadriceps femoris muscle, recovery

Introduction

Sports massage therapy is based on the classic Swedish massage and used in the rehabilitation of athletes, during the physical training process and to aid recovery. This massage is performed manually using techniques individually adapted to a given sport and dependent on the training phase [1]. One of the aims of sports massage therapy is to prevent the onset of pathologies resulting from overtraining, a common problem in competitive sport. It can be combined with other physiotherapy treatments including sauna, diadynamic currents, water and salt baths, paraffin compresses, and ultrasound and light therapies [1, 2].

Massage therapy produces numerous local and systemic effects. Locally, massaged tissue shows increased blood and lymph flow. Systemic effects are induced over time and benefit the circulatory, nervous and endocrine systems. Massage therapy, using suitable techniques, has been found to improve muscle and cutaneous tissue as well as the functioning of the excretory, respiratory and alimentary systems [3–6].

One of the body's responses to massage is a rise in the temperature of the massaged area by approximately 1.5–1.8°C. This effect is considered beneficial and used to help prepare athletes for optimal performance, such as by increasing muscular effort and starting efficiency before competition [7–9]. The centripetal, intracardiac direction of massage strokes accelerate the displacement of blood from venous and capillary vessels, allowing massaged tissue to quickly remove metabolic waste products and absorb nutrients more efficiently, mechanisms which are considered to be particular useful in post-exercise recovery [9–13].

However, the results of research on the effectiveness of massage are not univocal [14, 15]. Therefore, the aim of this study was to assess the effectiveness of sports massage in the reduction of delayed onset muscle soreness of the quadriceps femoris.

Material and methods

Twenty-nine women aged from 24 to 26 years were recruited. The sample was randomly divided into two groups: Group I (n = 15) received sports massage treatment after exercise. Group II (n = 14) was treated as the control and not subjected to any recovery treatment (Table 1). All participants provided their written informed consent.

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Tabela 1. Characteristics of the participants (mean ± *SD*)

Group	Participants (*n*)	Age (years)	Body mass (kg)	Body height (cm)
Group I (massage)	15	24.6 ± 1	57.3 ± 5.0	166.8 ± 0.6
Group II (control)	14	24.8 ± 1.4	57.0 ± 5.3	165.8 ± 0.6

Massage effects on lower limb power were investigated by using the vertical jump test after a squat jump exercise session. A subjective assessment of the level of post-exercise pain (muscle soreness) was performed using the visual analogue scale (VAS) [16]. Additional measures included heart rate before (at rest) and after the exercise session and an evaluation of training intensity using the Borg Rating of Perceived Exertion Scale [14].

The study procedure involved Groups I and II performing five sets of deep squat jumps at 60–100% maximum ability. The first set was performed until exhaustion, sets 2–4 were performed at 60–80% of their repetition maximum from the first set and the fifth set was again performed again until exhaustion. Lower limb power was then assessed by the vertical jump test and soreness intensity was rated using the VAS (Measurement 1). The power values recorded in Measurement 1 were treated as 100%. The vertical jump test and VAS was then administered 24 h (Measurement 2), 48 h (Measurement 3), 72 h (Measurement 4) and 96 h (Measurement 5) after the initial squat jump exercise session.

The experimental group received massage treatment approximately 2 h after each measurement. A sports massage involving manual therapy of the thigh muscles was performed by a physiotherapist. Treatment lasted approximately 20 min (10 min on each lower limb) while the participant lay on their back. Massage techniques included sliding, effleurage, rubbing, kneading and vibration [1].

Basic descriptive statistics (arithmetic mean and standard deviation) were calculated for all measures. Differences between vertical jump performance measurements were examined using the Friedman test with post-hoc testing via Fisher's least significance difference. Between-group differences were assessed using the Mann–Whitney U test. Statistical significance was set for all statistical procedures at $p \leq 0.05$.

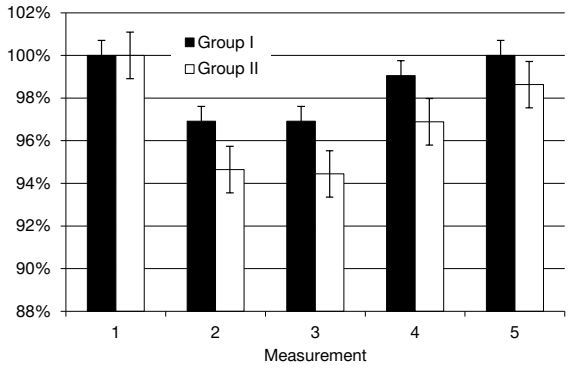

Figure 1. Lower limb power output via vertical jump testing (the results of Measurement 1 were treated as 100%)

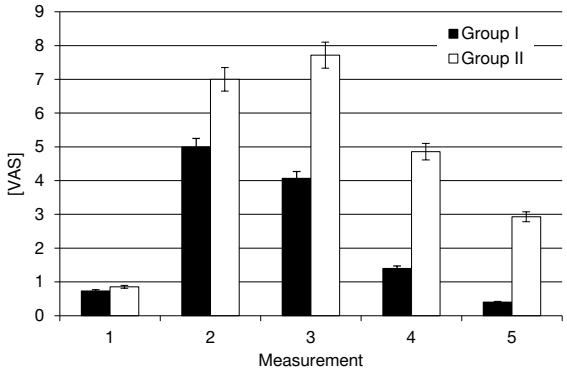

Figure 2. Level of muscle soreness based on visiual analogue scale (VAS)

Results

In both groups, the greatest statistically significant decrease in lower limb power was observed between Measurements 1 and 2. This trend was maintained up to 48 hours (Measurement 3) after the exercise session in the control group. The greatest improvement in power was noted between Measurements 3 and 4 in the massage group. Participants in this group also produced similar levels of power in the last measurement compared with the first (Figure 1).

The level of muscle soreness was rated the highest in Measurement 2, or 24 h post-exercise, by the massage group. In turn, the control group rated soreness the highest in Measurement 3. A significant decrease in muscle pain was noted in the massage group in each subsequent day, where on the last day of testing (Measurement 5) the level of pain was close to zero. The control group declared higher levels of pain in all measurements ($p < 0.001$) compared with the experimental group except for the initial measurement (Figure 2).

No significant between-group differences were observed for resting or post-exercise heart rate. Exercise intensity measured with the Borg Scale was rated similarly by all participants (15.87 by Group I vs. 15.43 by Group II).

Discussion

Massage has been practiced as a form of therapy since antiquity. Today, the effects of massage on the body are the subject of numerous studies, from exploring its physiological mechanisms to quantifying mental effects [9, 13, 17, 18]. Huang [15] studied the effects of short 10- and

30-s massage on thigh muscles (semimembranosus, semitendinosus and biceps femoris) and observed an improvement in hip joint range of motion, concluding that massage can serve as an alternative to static stretching. Wälchli et al. [5] demonstrated that rhythmical massage can produce a rise in surface temperature and increased heart rate variability and sympathetic stimulation. Long-term effects included an improvement in warmth distribution and stabilized resting heart rate. According to Goats [19], classic massage therapy should be applied in cases of prolonged inflammation, slowed healing or impeded lymphatic drainage. This author ascertained that a series of massage treatments can help with pain relief, restore muscle efficiency, and improve musculoskeletal system function.

The effectiveness of massage on reducing muscle soreness was studied by Willems et al. [12], finding massaged limbs recover quicker and exhibit less pain. Similar conclusions were reached by Zainuddin et al. [13], who showed a reduction in swelling as a result of massage therapy. The results of the present study confirm the above observations. The results also give credence to the idea that the possible benefit of massage therapy is in based on the increase in tissue temperature. The results of an experiment conducted by Petrofsky et al. [20] demonstrated that both dry and moist heat were very effective in reducing pain and muscle damage after exercise.

However, there are reports in the literature that do not confirm the health effects of post-exercise massage therapy. Robertson et al. [21] evaluated the effects of lower limb massage on recovery after intensive exercise on an ergometer. No measurable physiological effects were observed after massage therapy when compared with passive rest [21]. Another example was provided by Dawson et al. [22], who examined the influence of massage on lower limb power, swelling and pain after a half-marathon. No significant differences ($p > 0.05$) were found, although an improvement in over half of the examined subjective measures may indicate that massage instead provides a powerful psychological effect.

In this regard, the mental benefits of massage have been confirmed in many studies. The reduction in anxiety as a result of massage has been explained by increased secretion of endorphins and loosening tense muscle groups [17, 18, 23]. The relaxing effect of massage has been hypothesized to be two-sided in that it affects both mind and body. By decreasing muscle tension and improving blood circulation, massage induces feelings of relaxation and reduces pain [12, 19]. Such an improved state of mind was found to increase pain tolerance and performance [3, 23, 24] and may explain the results obtained in the present investigation.

Although the present results indicate that sports massage therapy helps reduce muscle soreness, the study has a number of limitations including the small sample size and the fact that muscle soreness was assessed subjectively. Accordingly, future research on the benefits of massage should include larger and more diverse samples (including males) and apply more objective investigative tools. One method with promising results is the use of infrared imaging, as it can non-invasively monitor changes in body surface temperature [25].

Conclusions

Massage therapy quickened recovery and improved muscle efficiency and may serve as an effective treatment of muscle soreness, especially during the competitive season when athletes must perform at maximum levels with limited rest.

Massage therapy induced an accelerated reduction in soreness after supramaximal effort. One of the main advantages of massage appears to be its analgesic effect and suggests it should be widely applied in sport, physical therapy and rehabilitation.

The results of the present study indicate the need for additional research including a larger sample and the utilization of more objective investigative tools.

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