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Reduction in pain intensity, range of motion and serum creatine kinase through manipulation of sport massage

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Abstract: This study aims to examine the effect of sports massage manipulation on serum creatine kinase levels, range of motion (ROM), and pain intensity following eccentric activity. Eccentric movements can lead to muscle damage and soreness due to maximal muscle lengthening to generate force, which increases serum creatine kinase, reduces ROM, and intensifies pain. This laboratory experimental study used a randomized pretest-posttest group design involving 30 males aged 21–24 years, divided into five groups: four treatment groups (effleurage, petrissage, shaking, and tapotement) and one control group. Participants performed 10 sets of drop jumps, followed by a 20-minute sports massage administered six hours later. ROM was measured using a goniometer, pain intensity with a visual analogue scale (VAS), and serum creatine kinase levels via laboratory analysis. Results showed a significant increase in knee ROM ($p = 0.019$) and a significant reduction in pain intensity ($p = 0.001$) 24 hours after activity. However, no significant change was observed in serum creatine kinase levels ($p = 0.525$). In conclusion, sports massage manipulation effectively improves ROM and reduces pain following eccentric activity but does not significantly affect serum creatine kinase levels.
Keywords: *Eccentric activity, Knee joint ROM, Pain intensity, Serum creatine kinase, Sports massage.*

1. Introduction

Pain management and post-workout recovery are important aspects of improving athletes' performance. One of the methods that is often used to treat muscle pain is sports massage. Sport massage is believed to reduce pain intensity and increase range of motion (ROM) in athletes after intensive training or injury. Recent research shows that sports massage can play a role in accelerating the recovery process by stimulating blood and lymphatic flow, reducing muscle tension, and lowering serum Creatine Kinase (CK) levels which often increase after strenuous physical activity [1, 2]. However, research gaps related to the biological mechanisms that occur and their effects on the decrease in serum CK and the increase in ROM still need to be explored deeper.

High-intensity exercise can cause micro-damage to muscle fibers that trigger inflammatory processes and increased serum CK levels. High serum CK levels indicate muscle damage and are associated with decreased muscle functionality such as ROM and strength. Some studies suggest that sport massage can help reduce serum CK levels, but the results often vary depending on the type and intensity of massage manipulation applied [3, 4]. The research gap lies in the disagreement regarding the most effective method of sport massage in reducing serum CK levels as well as its impact on muscle ROM after intensive exercise.

In the context of recovery, increasing muscle ROM is essential to prevent recurrence of injuries and improve athlete performance. Several studies have shown that sports massage can improve ROM by relaxing muscles and increasing soft tissue elasticity [5]. However, research examining the direct link

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between sport massage techniques and ROM enhancement is still limited. This raises questions about the most effective type of sport massage technique and the biomechanical mechanisms involved in the process.

Reducing pain intensity is one of the main goals of sports massage, but many studies suggest that the pain effects are only temporary and do not have a long-term impact on the physical condition of athletes [6, 7]. Differences in methodology and research samples make the conclusion about the effectiveness of sport massage in reducing pain still unclear. What's more, variables such as the duration and frequency of massages, as well as the techniques used, are often inconsistent in the existing literature.

On the other hand, the use of Creatine Kinase as an indicator of post-exercise muscle damage has been one of the most widely used methods in recovery-related research. However, although some studies suggest that sport massage can lower serum CK levels, most of these studies have not tested the differences in effects between different types of sport massage techniques [3, 8]. This shows that there is a gap in research that needs to be filled with a more in-depth analysis of the types of techniques and protocols used in the practice of sports massage.

Meanwhile, studies that combine the effects of sport massage on pain intensity, ROM, and serum CK levels in one study are still very rare. Most studies focus on just one of these variables [9]. Therefore, a study that combines these three variables can provide a more complete understanding of the impact of sport massage on athlete recovery.

In addition, the population of athletes used in most sports massage-related studies is still limited to elite or professional athletes, while recovery in beginner or amateur athletes also requires special attention [10]. Research examining the effects of sport massage on groups of athletes with varying levels of skill and experience in sports will open up new insights into the application of this method. This suggests that this research gap needs to be addressed to include a more diverse sample.

This study aims to fill these gaps by exploring the effect of sports massage on reducing pain intensity, increasing ROM, and decreasing serum CK levels in athletes. Thus, the results of this study are expected to make a significant contribution to the development of more effective recovery methods for athletes with diverse backgrounds.

2. Method

2.1. Types and Design of Research

This study is experimental research with a randomized pre-test and post-test group design. This design randomly divided the study subjects into several groups to compare the results before (pre-test) and after (post-test) of the intervention. This study aims to evaluate the effect of various sports massage manipulations on three main variables, namely *range of motion* (ROM), pain intensity, and serum *creatine kinase* levels after eccentric activity.

2.2. Participants

The study participants consisted of male students who were selected based on the following inclusion criteria: Male, Age 21-24 years, Weight 55-65 kg, physical habits have been accustomed to undergoing resistance activities for at least 6 months before, health conditions Do not have serious muscle injuries, have a normal body mass index (BMI), and have not used medications for at least 1 week before the study, Previous activity not doing eccentric activity in the last 3 days. Participants were grouped into five groups: (K1) *effleurage* manipulation group, (K2) *petrissage* manipulation group, (K3) *shaking* manipulation group, (K4) *tapotement* manipulation group, (K5) control group.

2.3. Research Instruments

This study uses a Goniometer instrument to measure *the range of motion* (ROM) in the knee joint passively, a Visual Analogue Scale (VAS) to measure pain intensity, with a scale of 0-10 based on the

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subject's perception, and a laboratory examination to measure serum *creatine kinase* levels in the blood, which is carried out in the laboratory.

2.4. Research Procedure

Eccentric activities are carried out through 10 sets of drop jumps (10 reps per set) with a recovery time of 1 minute between sets. The activity was carried out using a bench as high as 0.5 meters. Provision of *sports massage*: The intervention is carried out 6 hours after eccentric activity. Each manipulation (effleurage, petrissage, shaking, and tapotement) is administered for 20 minutes on the anterior and posterior limbs (left and right). The variable measurement of ROM was measured using a goniometer. Pain intensity was measured using the VAS scale. Serum *creatine kinase* levels are measured through laboratory analysis. In the control group was not given a *sports massage* intervention, but received the same manipulation after 24 hours as an ethical step of the study.

2.5. Data Analysis

Normality and homogeneity test to ensure normal and homogeneous data distribution. MANOVA (Multivariate Analysis of Variance) test to see the effect of the intervention on pain intensity and serum *creatine kinase* levels. Kruskal-Wallis Test: Used to compare changes in ROM between groups with a significant value at $p \leq 0.05$.

3. Results

The results of this study aim to evaluate the effectiveness of various sports massage manipulations on physiological parameters related to muscle recovery after eccentric activity, namely *range of motion* (ROM), pain intensity, and serum *creatine kinase levels.* In addition, the characteristics of the study subjects such as age, weight, height, and body mass index (BMI) were also analyzed to ensure the homogeneity of the group.

Table 1.
Characteristics of the Research Subject.

Variable	**K1 (n = 6)**	**K2 (n = 6)**	**K3 (n = 6)**	**K4 (n = 6)**	**K5 (n = 6)**	***P***
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	
Age (years)	19.83 ± 0.753	20.33 ± 0.516	20.17 ± 0.408	19.83 ± 0.983	20.67 ± 0.516	0.006
Weight (kg)	61.66 ± 3.141	58.16 ± 3.544	59.83 ± 3.060	61.83 ± 2.926	61.66 ± 3.723	0.950
Height (m)	1.69 ± 0.027	1.67 ± 0.009	1.70 ± 0.028	1.70 ± 0.048	1.69 ±0.030	0.026
IMT (kg/m2)	21.50 ± 1.120	20.70 ± 1.020	20.58 ± 0.688	21.31 ± 0.446	21.37 ± 0.826	0.746

Note: Remarks: Sig > 0.05

The data shows the mean ± standard deviation (SD) of variables such as age, weight, height, and body mass index (IMT) across five groups (K1 to K5). The p-value for age (0.006) indicates a significant difference in age across the groups, while other variables like weight (p=0.950), height (p=0.026), and IMT (p=0.746) show no significant differences, except for height which is marginally significant. This suggests that while age and height vary significantly among the groups, other factors like weight and IMT are fairly consistent across them.

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Table 2.
Description Of Research Data.

Creatine Kinase					
Group	**N**	**Mean ± SD**	***Shapiro Wilk***	***Lavene Test***	***P***
K1	6	105.67 ± 54.906	0.096	0.632	0.525
K2		105.50 ± 91.255	0.129		
K3		40.40 ± 66. 274	0.477		
K4		39.40 ± 52.147	0.377		
K5		72.33 ± 126.454	0.104		
Range of Motion (ROM)					
K1	6	9.33 ± 7.051	0.390	0.225	0.019
K2		13.00 ± 8.462	0.009		
K3		13.00 ± 7.583	0.814		
K4		8.20 ± 6.099	0.984		
K5		3.17 ± 2.223	0.329		
Pain Intensity					
K1	6	2.17 ± 0.753	0.314	0.817	0.001
K2		1.50 ± 0.837	0.325		
K3		2.20 ± 0.837	0.314		
K4		1.40 ± 0.548	0.325		
K5		3.83 ± 0.753	0.314		

Note: Remarks: Sig > 0.05.

The data presents the mean ± standard deviation (SD) for Creatine Kinase, Range of Motion (ROM), and Pain Intensity across five groups (K1 to K5). For Creatine Kinase, no significant differences were found ($p = 0.525$), as the Shapiro-Wilk and Levene tests show normal distribution and equal variance. However, for ROM, there was a significant difference ($p = 0.019$), indicating variability across groups, especially with K5 having the lowest ROM. Pain Intensity also showed a significant difference ($p = 0.001$), with K5 reporting the highest pain intensity. These results suggest that while Creatine Kinase levels remain consistent, ROM and pain intensity vary significantly between groups.

In all groups of research subjects on *serum creatine kinase*, the value of $p = 0.525 > 0.05$ was obtained, in all groups of research subjects for the *range of motion* (ROM) the value of $p = 0.022 < 0.05$, in all groups of research subjects on pain intensity was obtained a value of $p = 0.001 < 0.05$. So, it can be said that there is a significant influence after the administration of *sports massage* manipulation on *serum creatine kinase*, *range of motion* (ROM) and pain intensity after eccentric activity in study subjects.

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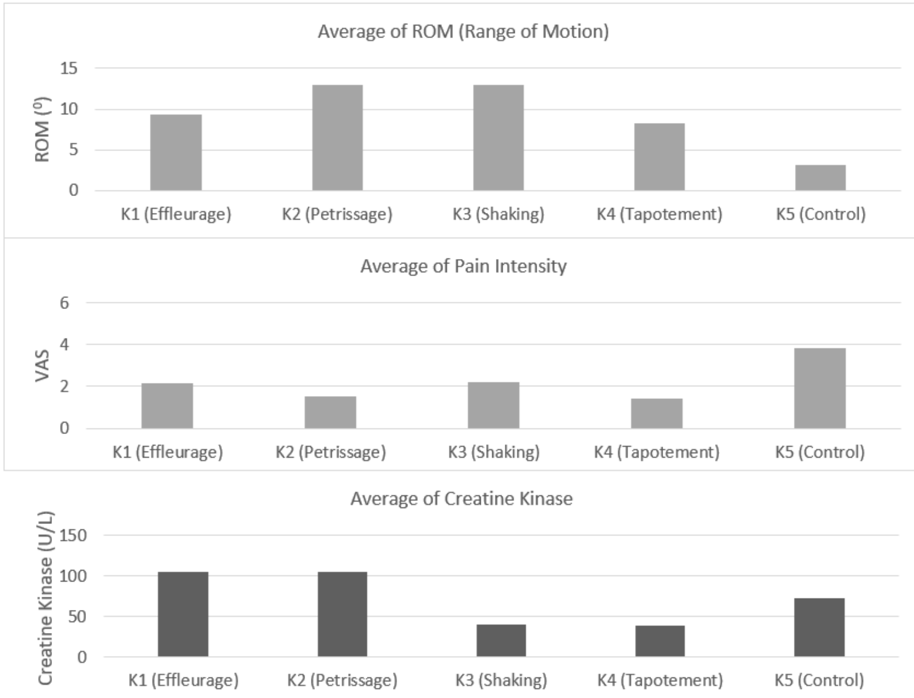

Figure 1.
Graph of creatine kinase, Range of Motion (ROM), Pain Intensity.

The image illustrates a comparison of the effects of massage techniques (Effleurage, Petrissage, Shaking, Tapotement) and control on ROM (Range of Motion), pain intensity (VAS), and Creatine Kinase Serum levels.

4. Discussion

The results of this study showed that the manipulation *of sport massage* had a significant effect on increasing *range of motion* (ROM) and decreasing pain intensity, but did not significantly affect serum *creatine kinase* levels within 24 hours after eccentric activity.

The increase in ROM was seen significantly in the treatment group (*effleurage*, *petrissage*, *shaking*, and *tapotement*) compared to the control group. *Petrissage* manipulation and *shaking* show the best results with the highest ROM increase. This is in line with Dakić, et al. [3] research which states that *sports massage* improves soft tissue flexibility through increased blood circulation and improved muscle tissue mobility. Another study by Davis, et al. [8] explained that the *shaking* technique is able to relax muscles and increase tissue elasticity, which contributes to the increase in Pain ROMs.

The manipulation *of sports massages* significantly reduced the intensity of pain compared to the control group. The *tapotement technique* gave the best results in reducing pain with an average VAS scale of 1.40 ± 0.548. This decrease is explained through the mechanism of Gate Control Theory, where the mechanical stimulus from massage closes the pain signal to the brain, thereby reducing the perception of pain [8, 11]. Research by Gholami [10] also supports that *sports massage* is effective in reducing post-workout pain through the release of endorphins that stimulate muscle relaxation.

Compared to previous studies, such as those found in a study by Heinke, et al. [9] and Dakić, et al. [3] which used *sports massage techniques* (Effleurage and petrissage), the results of this study are in line with their findings that although *massage* reduces muscle fatigue and increases ROM significantly, its effect on the reduction of *creatine kinase* levels not always consistent. It underscores the complexity of

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the physiological response to *massage therapy*, which may be influenced by variations in the type of physical activity performed, the duration of the intervention, as well as *the massage* techniques applied.

The results are also in line with other studies that show that *sports massage* can reduce *delayed-onset muscle soreness* (DOMS) and increase ROM in the short term, although effects on muscle performance or reduced *creatine kinase* levels are not always seen in the long term. For example, research by Sams, et al. [12] showed that although *massage* improved muscle flexibility, there was no significant reduction in *creatine kinase* in participants after a therapy session.

It is important to note that factors such as the *massage technique* used, the timing of the intervention, as well as the fitness status of the subject can affect the final result. Some studies have shown that the effects of *massage* are more significant in untrained subjects than in trained athletes, which may be related to psychological responses to treatment as well as a more positive perception of recovery.

Overall, this study makes an important contribution in understanding the effects of *sports massage* on muscle recovery after eccentric activity. Although *massage* has shown benefits for increasing ROM and reducing pain, the effect on *creatine kinase* which is an indicator of muscle damage is more limited, in line with previous studies that indicate results vary depending on a variety of factors. This study contributes to the understanding of the effectiveness of *sport massage* in the context of muscle recovery after eccentric exercise, but also emphasizes the importance of further research on the optimal technique, duration, and time for massage administration.

5. Conclusion

The conclusion of this study shows that the manipulation of *sport massage* (effleurage, petrissage, shaking, and tapotement) can significantly increase the range of motion (ROM) and reduce the intensity of pain in the muscles after eccentric activity. However, there was no significant effect on serum creatine kinase levels, which indicates muscle damage. These results are consistent with previous research showing that although *massage* is effective in reducing pain and improving flexibility, its impact on *creatine kinase reduction* is limited.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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