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The Effectiveness of Effleurage and Trigger Point Techniques in Reducing Delayed Onset Muscle Soreness of the Quadriceps

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Abstract. Injuries resulting from physical activity can limit an individual's mobility and performance. Appropriate therapeutic interventions are therefore required to minimize the risk and impact of injury. The present study aims to examine the effectiveness of a combination of effleurage and trigger point therapy in reducing pain caused by delayed onset muscle soreness (DOMS) among Muara Enim United athletes. The research employed a quasi-experimental design using a one-group pretest–posttest approach. A total sampling technique was applied, involving sixteen athletes as both the population and sample. The treatment was administered three times over the course of one week. Data were analyzed using the Wilcoxon test with the SPSS version 26 software. The independent variable was the combination of effleurage and trigger point therapy, while the dependent variable was the intensity of delayed onset muscle soreness. The results indicated a decrease in the mean pain score on the Visual Analogue Scale (VAS) to 3.8/10 after three treatment sessions. The findings demonstrate that the combination of effleurage and trigger point therapy effectively reduces pain intensity associated with DOMS when applied three times within one week.
Keywords: delayed onset muscle soreness (DOMS); effleurage; trigger point therapy

Abstrak. Cedera yang terjadi akibat aktivitas fisik dapat membatasi pergerakan dan performa seseorang. Oleh karena itu, diperlukan intervensi terapi yang tepat untuk meminimalkan risiko serta dampak cedera. Penelitian ini bertujuan untuk menguji efektivitas kombinasi teknik pijat *effleurage* dan *trigger point therapy* dalam menurunkan nyeri akibat *delayed onset muscle soreness* (DOMS) pada atlet Muara Enim United. Penelitian ini menggunakan desain quasi-eksperimen dengan rancangan *one group pretest–posttest*. Teknik pengambilan sampel menggunakan total sampling dengan jumlah populasi dan sampel sebanyak enam belas atlet. Perlakuan diberikan sebanyak tiga kali dalam jangka waktu satu minggu. Analisis data menggunakan uji Wilcoxon dengan bantuan program SPSS versi 26. Variabel bebas dalam penelitian ini adalah kombinasi teknik *effleurage* dan *trigger point therapy*, sedangkan variabel terikat adalah intensitas nyeri DOMS. Hasil penelitian menunjukkan penurunan nilai rata-rata nyeri pada *Visual Analogue Scale* (VAS) menjadi 3,8/10 setelah tiga kali perlakuan. Temuan ini membuktikan bahwa kombinasi pijat *effleurage* dan *trigger point therapy* efektif dalam menurunkan intensitas nyeri akibat DOMS dengan pemberian terapi sebanyak tiga kali dalam satu minggu.
Kata kunci: *delayed onset muscle soreness (DOMS); effleurage; trigger point therapy*

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INTRODUCTION

Excessive physical activity during exercise or daily routines can cause tissue damage that leads to injury (Wicaksono, 2020). Injuries represent physiological disturbances in body tissues resulting from mechanical stress or overexertion. According to Imtikhani et al. (2022), such injuries trigger clinical responses characterized by rubor (redness), tumor (swelling), calor (heat), and dolor (pain). Although physical activity provides numerous health benefits, it can also generate adverse effects such as fatigue and musculoskeletal injury when performed excessively or without proper preparation (Purnomo, 2016).

Previous studies have reported a relatively high incidence of injuries during physical education activities. Supriyadi et al. (2017) found that 30% of students at SMA Negeri 1 Nalumasari experienced lower-limb injuries of varying severity ranging from mild to severe affecting bones, muscles, ligaments, and joints. Graha (2019) further noted that such injuries occur either through contact or non-contact mechanisms, with non-contact injuries being more prevalent and recurrent (Bisciotti et al., 2019). These findings suggest that inadequate conditioning, overtraining, and improper movement execution are major contributing factors to the onset of physical activity–related injuries.

Young athletes are particularly vulnerable to injury due to repetitive strain and high training loads. Strosser (2023) emphasized that early sport specialization increases injury susceptibility, recommending delayed specialization until adolescence to reduce risk. Similarly, Emery et al. (2010) highlighted that insufficient body readiness before activity remains a leading cause of sports injuries. Pre-activity assessments and proper warm-ups are therefore essential preventive strategies to ensure physiological preparedness and minimize musculoskeletal strain.

One of the most frequent post-exercise conditions associated with strenuous activity is delayed onset muscle soreness (DOMS). DOMS refers to muscle pain and stiffness that develop within 24 to 48 hours following physical exertion (Rahman et al., 2022). The discomfort results from microscopic muscle fiber damage and subsequent tissue repair processes. Although DOMS represents a natural adaptive response, its presence often restricts mobility and diminishes performance efficiency (Refiater et al., 2022). High-intensity exercise and eccentric muscle contractions increase susceptibility to DOMS (Sari, 2016).

Massage therapy is recognized as one of the most effective interventions for alleviating muscle pain and accelerating recovery. According to Alfaris et al. (2024), sports massage involves complex manual manipulations performed with the hands to promote relaxation, improve circulation, and reduce post-exercise pain. Among the various techniques, effleurage and trigger point therapy are commonly applied to manage muscle discomfort. Effleurage involves smooth, rhythmic strokes using the palms to promote relaxation and enhance blood flow in superficial muscle layers (Sari et al., 2019). The gentle, continuous motion aids venous return and facilitates the removal of metabolic waste, thereby reducing muscle tension.

Trigger point therapy, on the other hand, focuses on specific points within muscle fibers known as myofascial trigger points hyperirritable spots that cause referred pain and muscle stiffness (Husnayati et al., 2021). The technique involves direct pressure or circular movements on these points to relax contracted fibers and restore normal muscle function. According to Putri et al. (2020), trigger point therapy relieves tension, repairs soft tissue structures, and restores functional movement within a shorter recovery period. Moraska et al. (2017) found that pressure applied during trigger point therapy can induce temporary discomfort due to muscle tension release; therefore, combining it with effleurage may produce a synergistic effect by simultaneously reducing pain and improving circulation.

In the current study, the combination of effleurage and trigger point therapy is applied as an integrated treatment to reduce muscle pain associated with DOMS. The complementary nature of both methods is expected to enhance therapeutic outcomes by addressing both superficial and deep muscle tension. Effleurage facilitates relaxation and circulation, while trigger point therapy targets localized areas of muscle tightness, collectively promoting faster recovery and pain reduction.

Pain intensity in the study is measured using the Visual Analogue Scale (VAS), a widely adopted instrument for assessing subjective pain perception. According to Chiarotto et al. (2019), VAS is among the most valid and reliable tools for quantifying pain levels. The scale ranges from 0 to 10, where 0 represents no pain, 1–3 indicates mild pain, 4–6 reflects moderate pain, and 7–10 corresponds to severe pain (Bijur et al., 2001; Pinzon, 2016). The use of the VAS allows for precise documentation of changes in pain perception before and after treatment, thereby facilitating an objective evaluation of therapeutic effectiveness.

METHODS

The research employed a quasi-experimental design with a one-group pretest–posttest approach. The purpose of this method was to determine the relationship between cause and effect through pre- and post-intervention measurements. The structure of the research design is presented in Figure 1.

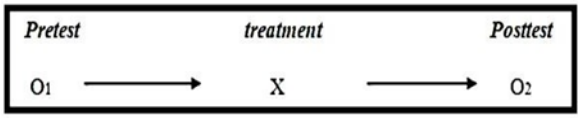

Figure 1. Research Design

Description:
O1 = Pre-test measuring pain using VAS sheets on Muara Enim United athletes.
X = Combination treatment of effleurage and trigger point therapy on athletes three times for one week.

O2 = Post-test measuring pain using VAS sheets on Muara Enim United athletes.

This study was conducted on 16 female athletes from the Muara Enim United Club between May 22–28, 2024. The intervention was administered three times a week, with each session lasting 30 minutes. The treatment procedure is detailed in Table 1.

Table 1. Treatment Details

Treatment	Target Area	Time (minutes)
Trigger Point Therapy	Rectus Femoris	2.5
	Vastus Medialis	2.5
	Vastus Lateralis	2.5
	Vastus Intermedius	2.5
Massage Effleurage	Rectus Femoris	5
	Vastus Medialis	5
	Vastus Lateralis	5
	Vastus Intermedius	5
Total Duration		**30 minutes**

The independent variable in this study was the combination of effleurage and trigger point therapy, while the dependent variable was the reduction in Delayed Onset Muscle Soreness (DOMS) intensity. The research instrument utilized was the Visual Analogue Scale (VAS), a reliable measure for assessing subjective pain intensity. The population consisted of 16 Muara Enim United athletes, all of whom met the inclusion criteria. The sampling technique used was total sampling, as the entire population qualified for participation.

Sample inclusion criteria:
1) Registered Muara Enim United athletes.
2) Experienced post-exercise pain complaints.
3) Recorded VAS scores greater than 6 prior to treatment.
4) Female participants.
5) Provided informed consent to participate.

Based on these criteria, a total of 16 athletes were selected as research subjects. The demographic characteristics of the participants are presented in Table 2.

Table 2. Sample Characteristics

Variable	n = 16	Percentage (%)
Age (Years)		
20–25	10	62.5
26–30	2	12.5
31–35	4	25.0

Table 2 illustrates the age distribution of the study participants. Among the sixteen athletes, ten (62.5%) were between 20–25 years, two (12.5%) were aged 26–30 years, and four (25.0%) were aged 31–35 years. The sample represents a homogeneous group of adult female athletes, all of whom actively engaged in regular physical activity and reported experiencing post-exercise muscle soreness in the quadriceps region. The design allowed for objective comparison between pretest (O_1) and posttest (O_2) results, ensuring that any observed reduction in pain intensity could be attributed to the combination therapy of effleurage and trigger point techniques.

RESULTS AND DISCUSSION

Data collected from the research conducted on April 22–28, 2024, were analyzed statistically using SPSS version 26. The data processing involved a Wilcoxon non-parametric test after preliminary normality and homogeneity tests were performed to ensure appropriate statistical procedures.

Table 3. Descriptive Data

Variable	n	Mean ± SD	(min–max)
Age (years)	16	24.8 ± 3.8	21–35
Pain pre (VAS)	16	7.1 ± 0.7	6–8
Pain post (VAS)	16	3.4 ± 0.8	2–5

Based on the data presented in Table 3, the age of the participants ranged between 21 and 35 years with a mean of 24.8 years. The mean Visual Analogue Scale (VAS) pain score before treatment was 7.1, indicating moderate to severe pain levels (6/10–8/10). After treatment, the mean pain score decreased to 3.4, corresponding to mild to moderate pain levels (2/10–5/10). The descriptive analysis thus indicates a substantial reduction in pain following the combination of effleurage and trigger point therapy.

Normality Test

The Shapiro–Wilk test was used to assess data normality, as the sample size was fewer than 50 participants. Data are considered normally distributed when $p > 0.05$.

Table 4. Data Normality Test

Group	Sig. (p)	Description
Pre-test	0.003	Abnormal
Post-test	0.036	Abnormal

The results in Table 4 show that both pre-test and post-test data had significance values $p < 0.05$, indicating that the data were not normally distributed. Consequently, a non-parametric statistical test was required for further analysis.

Homogeneity Test

The Levene test was performed to determine whether the data exhibited homogeneous variance across groups. The data are considered homogeneous when $p > 0.05$.

Table 5. Homogeneity Test

Group	Df1	Df2	p-value
Pre-test	2	12	0.944
Post-test	2	13	0.486

As shown in Table 5, both pre-test and post-test data produced p-values greater than 0.05, indicating that the sample data were homogeneous and suitable for comparison.

Wilcoxon Signed-Rank Test

Given that the data were not normally distributed, the Wilcoxon Signed-Rank Test was used to compare pre-test and post-test results. This test evaluates whether a significant difference exists between paired observations before and after the treatment.

Table 6. Wilcoxon Test

Post-test – Pre-test	N	Mean Rank	Sum of Ranks
Negative Ranks	16a	8.50	136.00
Positive Ranks	0b	0.00	0.00
Ties	0c	–	–
Total	16		

a. Post-test < Pre-test
b. Post-test > Pre-test
c. Post-test = Pre-test

The analysis in Table 6 demonstrates that all 16 respondents experienced a decrease in pain intensity from pre-test to post-test. The mean rank of 8.50 and a sum of ranks of 136.00 indicate a consistent reduction in VAS scores following the intervention. No participants reported identical pre-test and post-test scores, signifying a uniform improvement across all subjects.

Table 7. Statistical Test Results

Post-test – Pre-test	Z	Asymp. Sig. (2-tailed)
	-3.559	0.000

The Wilcoxon test results in Table 7 show a Z-value of -3.559 and an Asymp. Sig. (2-tailed) value of 0.000. Since the significance level $p < 0.05$, the alternative hypothesis (H_a) is accepted, and the null hypothesis (H_0) is rejected. This finding confirms a statistically significant difference between the pre-test and post-test measurements. In other words, the combination of effleurage and trigger point therapy significantly reduced the intensity of Delayed Onset Muscle Soreness (DOMS) among Muara Enim United athletes.

Musculoskeletal injury refers to tissue damage involving muscles, ligaments, joints, or bone that arises from excessive loading and often restricts range of motion (Setyaningrum, 2019). Preventive strategies span neuromuscular conditioning, rule modifications, and provision of appropriate facilities and treatment pathways (Emery et al., 2019). Within that broad landscape, delayed-onset muscle soreness (DOMS) occupies a unique position because soreness develops after exertion, impairs subsequent performance, and reflects micro-damage within muscle fibers (Annafi & Mukarromah, 2021). The present investigation addressed that problem by testing whether a combined manual therapy protocol effleurage followed by trigger point therapy would meaningfully reduce DOMS among club athletes within a short, operationally realistic window of one week.

The study produced a clear pattern of improvement. Pain intensity on the visual analogue scale declined from a mean pretest value representing moderate severe discomfort to a posttest mean in the mild–moderate range, with Wilcoxon statistics confirming a significant change. The direction and magnitude of change align with the biological rationale for manual therapy in exercise recovery. Effleurage employs long, rhythmic strokes that enhance superficial venous and lymphatic return and promote parasympathetic dominance; both responses support clearance of metabolites and reduction of nociceptive input (Sari et al., 2019; Weerapong et al., 2005). Trigger point therapy targets hypersensitive loci within taut bands of muscle, reducing abnormal end-plate noise and restoring sarcomere length uniformity, which enhances mechanical efficiency and reduces referred pain (Husnayati et al., 2021; Putri et al., 2020). Sequencing effleurage with trigger point pressure likely amplified the analgesic effect by first preparing tissues through increased perfusion and then resolving focal hyperirritability.

A key gap in the applied sports-medicine literature concerns pragmatic, low-resource protocols that can be deployed by community clubs. Many investigations evaluate single modalities in controlled environments or emphasize equipment-intensive recovery methods that may not translate to grassroots settings. The present study fills that gap by demonstrating that a simple, time-bounded sequence 30 minutes per session, three sessions across one week produced consistent improvements among adult female athletes. The protocol focused on the quadriceps group (rectus femoris, vastus medialis, vastus lateralis, vastus intermedius), which performs substantial eccentric loading during deceleration and

cutting, a known driver of DOMS. Targeting the primary symptomatic region improved external validity for team-sport contexts where quadriceps soreness commonly limits training quality.

Novelty centers on two aspects. First, the investigation evaluated a combined approach rather than isolating a single technique. The synergistic logic rests on complementary mechanisms: effleurage for circulatory and autonomic modulation; trigger point pressure for focal nociceptive control. Second, the work standardized dose and distribution across the four quadriceps heads, allowing reproducibility for clinicians and coaches. Many massage studies report total session duration without specifying segmental allocation; the present protocol allocated equal trigger point duration (2.5 minutes per head) followed by equal effleurage duration (5 minutes per head), offering a transferable template for practice and future trials.

The findings support a mechanistic interpretation grounded in current evidence. DOMS involves Z-line streaming, sarcomeric disruption, and inflammatory signaling that peaks 24–48 hours after eccentric loading, coinciding with sensitization of group III/IV afferents. Manual pressure over trigger points may desensitize nociceptors through spinal segmental inhibition and activation of descending pain-modulatory pathways. Effleurage likely augments recovery by enhancing microcirculation, reducing interstitial edema, and promoting a shift toward parasympathetic tone, reflected historically in reductions of cortisol and improvements in heart-rate variability after massage (Weerapong et al., 2005). The integrated protocol, therefore, addresses both peripheral and central contributors to pain perception.

Methodological choices strengthened causal inference within the constraints of a quasi-experimental design. The one-group pretest–posttest structure enabled each athlete to serve as a matched control across time, minimizing between-subject heterogeneity. Non-parametric analysis was appropriate after normality testing identified non-Gaussian distributions, and homogeneity checks supported consistent variance across observations. Although the absence of a parallel control arm limits definitive attribution, the uniform direction of change negative ranks for all participants reduces the likelihood that regression to the mean alone explains the results. Future research can address residual confounding with randomized controlled designs that include sham manual therapy or alternative active comparators such as active recovery or stretching.

Relevance for practice emerges across several domains. Sports-medicine personnel in clubs often face time pressure, limited equipment, and varied athlete availability. A 30-minute protocol requiring only trained hands and basic documentation meets those constraints. Visual analogue scale tracking provides a quick, validated outcome measure for daily decision-making around training loads (Kliger et al., 2015). Adoption of a standardized manual sequence can also harmonize practice across therapists, reducing variability in care. Coaches gain a clear timeline: three sessions within one week following heavy eccentric exposure, aiming to restore training readiness while reducing reliance on pharmacologic analgesics.

The investigation also intersects with injury-prevention frameworks. Emery et al. (2019) emphasized neuromuscular training and environmental modifications; recovery strategies complement those pillars by sustaining training quality across microcycles. Hickey et al. (2022) argued that practitioners must understand mechanisms to prevent recurrence. The present protocol addresses a mechanism localized hyperirritability within overloaded fibers rather than solely masking symptoms. Faster pain resolution may allow progressive loading without compensatory mechanics that propagate secondary injuries.

Limitations inform directions for future work. The sample comprised sixteen female athletes from a single club, which supports internal coherence but constrains generalizability across sexes, ages, and sport types. Objective markers such as pressure-pain thresholds, serum creatine kinase, or quadriceps torque would enrich mechanistic understanding beyond self-reported pain. A crossover design comparing sequence order trigger point first versus effleurage first could clarify whether priming with effleurage contributes additional benefit. Dose-response studies are warranted to define minimal effective dose and potential ceiling effects. Maintenance effects beyond one week remain unknown; longitudinal follow-up could determine whether regular incorporation into training cycles sustains benefits or reduces time-loss due to soreness.

Despite those constraints, contributions to science and society are tangible. The study provides a replicable field protocol that integrates two well-known manual techniques within a coherent clinical reasoning framework. Community clubs, school teams, and recreational leagues can implement the sequence with modest training and no capital expenditure. Athletes benefit through faster pain reduction,

improved comfort during subsequent sessions, and potentially lower reliance on non-steroidal anti-inflammatory drugs. Health systems benefit indirectly through reduced clinic visits for benign post-exercise soreness, freeing capacity for more serious conditions.

Theoretical implications extend to blended recovery models. Evidence supports multimodal strategies nutrition, sleep hygiene, active recovery, and manual therapy rather than single-modality solutions. The present results suggest that pairing circulatory-oriented strokes with focal myofascial techniques yields additive benefits for DOMS. That concept can guide protocol development for other muscle groups that commonly exhibit post-exercise soreness, such as gastrocnemius–soleus after plyometrics or hamstrings after Nordic curls. Translating the quadriceps template to those regions would only require redistribution of the per-head durations.

The findings also speak to measurement practice. VAS remains a sensitive tool for within-subject change detection (Chiarotto et al., 2019). Categorization thresholds commonly assign scores above six to severe pain (Bijur et al., 2001; Pinzon, 2016). Movement from severe toward mild–moderate categories after one week provides a clinically meaningful signal that complements statistical significance. Embedding VAS checks before each session can guide day-to-day adjustments in manual pressure and stroke cadence, personalizing care without sacrificing standardization.

CONCLUSION

The research concludes that the combination of effleurage massage and trigger point therapy effectively reduces pain associated with delayed onset muscle soreness (DOMS) among Muara Enim United athletes. The treatment produced a substantial improvement in muscle comfort and recovery, demonstrating that integrated manual therapy targeting both superficial and deep muscle structures facilitates faster pain relief and functional restoration. The findings confirm that the combined approach offers an effective, accessible, and non-pharmacological intervention for managing post-exercise muscle soreness. Scientifically, the study contributes to evidence-based sports rehabilitation by supporting the use of complementary massage techniques as part of recovery protocols. The results highlight the importance of adopting integrated, low-cost therapeutic strategies that can be applied in community sports settings to enhance athlete performance, promote recovery, and prevent overuse-related complications in future training and competition contexts.

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