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Effect of Proprioceptive Neuromuscular Facilitation (PNF) and Sport Massage on Muscle Soreness Among Negeri Sembilan U-19 Junior League Hockey Players

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Abstract | Muscle soreness is a frequent issue for hockey players due to the sport's high intensity, involving explosive movements, quick direction changes, and physical contact. Delayed Onset Muscle Soreness (DOMS) refers to the discomfort characterized by soreness, stiffness, tightness, swelling, and muscle weakness experienced 24 to 72 hours after engaging in intense or unfamiliar exercise. Previous studies have suggested that PNF stretching might be an effective strategy for athletes to accelerate recovery, but further research is necessary. Similarly, research has indicated that sports massage could enhance recovery and lessen muscle soreness, though additional studies are required. The purpose of this study was to compare the effects of PNF stretching and sports massage in alleviating muscle soreness among Negeri Sembilan junior league hockey players after a match. There were 10 participants exposed to the PNF stretching group and sports massage group. This study was a quasi-experimental design. For PNF stretching, participants started by holding the position for 10 seconds, and the player pressed back against the trainer for 6 seconds. The trainer resisted and kept the leg in the same position. Finally, the player engaged his hip muscles while the trainer carefully pushed the leg to its maximum stretch. They performed one repetition for each muscle. For sports massage, a certified sports therapist administered 20-minute treatments using hypoallergenic oil, massaging each muscle group for 2.5 minutes with effleurage, petrissage, and tapotement, including cupping, hacking, and knuckling. The participant's pain scale (PS), knee range of motion (ROM), and muscular power (PWR) were recorded at five different time points: before the match, immediately after the match, and 24-, 48-, and 72-hours post-treatment. The differences in muscle soreness scores between the two groups were analyzed using repeated measures ANOVA. The results indicated that both proprioceptive neuromuscular facilitation stretching (PNF) and sports massage had a significant effect on the pain scale (PS), knee range of motion (ROM), and muscular power (PWR) between five time frames ($p < 0.05$). Therefore, there was a significant difference in the effect of PNF stretching and sports massage. It can be concluded that PNF stretching was the best treatment overall for hockey players to reduce soreness after a match or training.

Keywords: *Technical characteristics, men's singles badminton, comparative analysis, notational analysis, performance strategies.*

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I. Introduction

Delayed Onset Muscle Soreness (DOMS) includes soreness, stiffness, tenderness, swelling, and muscle weakening, appearing around 8 hours post-exercise, peaking at 24 to 48 hours, and gradually subsiding. While the exact cause is unclear, possible factors include connective tissue injury, metabolic waste buildup, and muscular spasm [1]. DOMS can significantly impair functional status, often requiring physical therapy. Various treatments, such as medications, herbal remedies, massage, and hot/cold packs, have been suggested, though their effectiveness is uncertain. Recent studies have explored eccentric workouts and non-traditional cryotherapy for treating DOMS [1]. Therapeutic techniques for DOMS include warming up, stretching, massage, acupuncture, and medication therapy. PNF stretching has been shown to reduce pain and improve functionality in exercise-induced muscle damage (EIMD) patients, especially when combined with plyometric training [2]. PNF, a rehabilitation method, enhances muscle recovery through contraction and relaxation techniques and is crucial for improving performance in competitive sports [3]. Understanding and managing muscle soreness is vital for athletes, including hockey players, as it can hinder performance and recovery. This research explored the impact of PNF and sports massage on muscle soreness among Negeri Sembilan junior league U19 hockey players. Sports massage, recognized for improving performance, preventing injury, and speeding recovery, manipulates soft tissues to reduce pain, improve circulation, and enhance muscle function [4]. Studies have shown sports massage reduces muscle soreness and improves recovery [5] [6]. It also enhances mood and well-being [7] and aids in muscle recovery while lowering inflammatory markers [8]. Effective management of muscle soreness in hockey players is crucial for performance, injury prevention, training continuity, mental well-being, and long-term health. By investigating PNF and sports massage, this study aimed to enhance the well-being and performance of these athletes.

II. Methods

The study used a quasi-experimental design to assess the effects of proprioceptive neuromuscular facilitation (PNF) stretching and sports massage on muscle soreness. This design helped establish causal links between the interventions and muscle soreness. Data were collected at five time points: before, immediately after, and 24-, 48-, and 72-hours post-competition. Participants were selected from the Negeri Sembilan junior league U19 hockey team using purposive sampling, focusing on those experiencing DOMS. The required sample size was calculated using G*Power, resulting in 10 participants with a 20% dropout rate, leading to 11 participants. Ten highly trained hockey players from Negeri Sembilan were recruited.

PNF Stretching: This study used the contract-relax method of PNF stretching. The athlete held a position for 10 seconds, then pressed back against the trainer for 6 seconds while the trainer resisted [19]. The trainer then pushed the leg into a maximum stretch [9]. This method targeted the quads, hamstrings, glutes, hips, and calves with one repetition per muscle.

Sports Massage: A 30-minute lower body sports massage was used to speed up recovery. Athletes lay face down for assessment and massage. A level 1 certified sports therapist administered a 20-minute massage using water-soluble hypoallergenic oil. Each muscle group (quadriceps, hamstrings, and calves) received 2.5 minutes of massage: 1 minute of effleurage (120 strokes/min), 45 seconds of petrissage (120

strokes/min), and 45 seconds of tapotement (240 contacts/min). Tapotement included 15 seconds each of cupping, hacking, and knuckling [10].

Pain Scale – Visual Analogue Scale: Participants assessed their pain levels on a 0-10 scale, with 0 indicating no pain, 1-5 indicating moderate pain, and 6-10 indicating severe pain. The visual analogue scale (VAS) featured a 10-cm horizontal line to quantify pain perception. Participants rated their pain at rest and during movement before and after the intervention, immediately after the match, and at 24-, 48-, and 72-hours post-treatment to evaluate the impact of therapies on discomfort [11].

Range of Motion—Goniometer: Active range of motion (AROM) was measured using a goniometer, which consists of a protractor attached to two perpendicular arms. The device was calibrated before each use to ensure accuracy. The knee's range of motion, commonly affected by exercise-induced muscle soreness, was measured before the match, after the match, 24-, 48-, and 72-hours post-treatment. Measurements were recorded on a standardized form [12].

Muscular Power–Vertical Jump: The vertical jump test used a Vertec device to measure jump height. Athletes performed a maximal vertical jump, and the highest vane touched was recorded. The test was conducted before the match and 72 hours post-match, coinciding with the peak of DOMS, and repeated under consistent conditions with a standardized warm-up to ensure reliability [13].

III. Results and Discussion

The normality of data for pain scale, muscular power, and range of motion was analyzed before the application of statistical tests. Normality of data was checked through skewness, kurtosis and Shapiro-Wilk test values. For a sample size of 10. The value of skewness and kurtosis of not less than -2 and not more than 2 conclude that all the variables were normally distributed. As data was found to be normally distributed, parametric tests were applied. Repeated measure ANOVA technique was applied to find within group differences for all outcome measures at different time points.

TABLE 1
SHOWING P-VALUE WITHIN-SUBJECT AND BETWEEN-SUBJECT FOR ALL OUTCOMES MEASURES

Variables	*p*-value	
	Effects	**Source**
PS	< 0.001	0.078
ROM	< 0.001	0.012
L/R	< 0.001	0.014
PWR	< 0.001	0.432

**PS= Pain Scale, *ROM L/R= Rain of Motion Left / Right,*
**PWR= Muscular Power*

Table 1 shows the inferential statistics for PS, ROM, and PWR, which were analyzed using repeated measures ANOVA. The table shows that there was significant improvement in all outcome measures across 5-time frames of treatment in subjects of all groups with p value < 0.05. Figure 1 shows that PNF leads to quicker pain recovery (PS: 2.68 vs. 3.2) and better range of motion (AROM: 131 vs. 123) compared to sport

massage. However, sport massage slightly improves muscular power more than PNF (52.3 vs. 50.9). In conclusion, PNF effectively reduced pain and increased ROM, while sport massage enhanced muscular power. Both therapies significantly impacted all biomarkers, but no significant difference was found between them. Thus, the null hypothesis for pain scale and knee ROM was rejected.

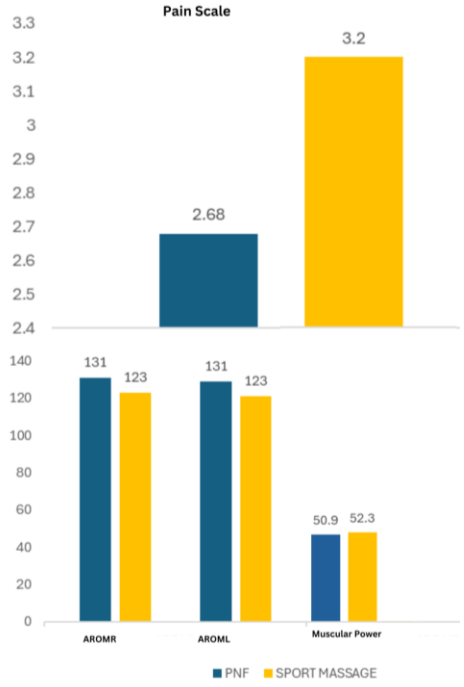

Fig. 1 Showing mean value for range of motion, muscular power and pain scale

IV. CONCLUSIONS

This study examined the effects of Proprioceptive Neuromuscular Facilitation (PNF) stretching and sports massage on muscle soreness, range of motion (ROM), and muscular power among U19 hockey players. Pain was measured using a visual analogue scale (VAS), ROM with a goniometer, and muscular power with a vertical jump test. PNF stretching showed significant improvements in pain reduction and ROM compared to sports massage [1] [11]. However, both treatments had similar outcomes for muscular power [14]. PNF's effectiveness is attributed to increased blood flow, endorphin release, and neuromuscular efficiency, while sports massage aids recovery by reducing inflammation and improving circulation [15] [16]. The findings highlight the benefits of PNF stretching for pain relief and flexibility, which are essential for athletic performance [17] [18].

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