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Effectiveness of Proprioceptive Neuromuscular Facilitation in Gluteus Medius Activation for Low Back Pain among Tailors

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Abstract Work-related low back pain (LBP) is the most frequent musculoskeletal condition among tailors. Prolonged working in a sitting position with a poor ergonomic pattern of the trunk can elevate the risk of LBP. The gluteus medius (GM) is important for lumbar spine stability while doing work in a sitting position over a period of time. The study aimed to find out the efficacy of proprioceptive neuromuscular facilitation (PNF) for gluteus medius muscle with elastic tubing resistance exercises to improve gluteus medius activation for LBP among tailor populations. In total, 48 participants were involved in this study, which were divided into 2 groups, experimental group (EG) (n = 24) and control group (CG) (n = 24). EG received PNF with elastic tube resistance exercises, and the CG received PNF without elastic tube resistance exercises. Electromyography (EMG) and the numerical pain rating scale (NPRS) were taken as baseline measures in both groups before the intervention and post-values were taken after 4 weeks of intervention in order to know the effectiveness of the intervention. The elastic tubing resistance and PNF combined intervention exhibited a substantial improvement in the post-test, suggesting that the elastic tubing resistance would enhance GM activation. In terms of clinical efficacy, a spiral diagonal D2F movement pattern and elastic tubing with an average peak tension of roughly 90% body mass may be used to boost GM muscle activation on both stance and movement patterns at the same time to overcome low back pain among the tailor population.

Keywords Electromyography, Human Health, Low Back Pain, Resistance Training, Proprioceptive Neuromuscular Facilitation

1. Introduction

Low back pain (LBP) is a worldwide public health concern [1]. Literature suggests that 25% of the Indian population had at least one episode of LBP over their lifetime. Low back pain can be caused by musculoskeletal dysfunction, structural failure, immune system responses, genetic predisposition factors, dynamic loading, emotions, mental and lifestyle exposures [2]. Mechanical factors are the most prevalent cause of low back pain, accounting for

over 97 percent of cases [3]. Often Low back pain is seen among the working population which is supported with a meta-analysis study, which quantifies and highlights certain risk factors of working in night shifts, overweight and work that requires prolong standing or sitting [4]. Several epidemiological and biomechanical investigations have found a relationship between the cause of LBP and poor posture either in sitting or standing. Further, the statement is supported by another study which claims that extreme awkward trunk postures may lead to the development of LBP and long durations of seated employment have been associated with increased risk of developing LBP [5-8].

Furthermore, studies have shown that lumbopelvic stability is related to functional limitations in people who work in sedentary occupations like software development, office work, driving, and tailoring. This is because sedentary work alters spinal curvature, which changes how the gluteus medius and minimus muscles contract and can lead to low back pain (LBP), and this factor is often unnoticed or underestimated in both analysis and therapeutic applications [9-11]. The gluteus medius inefficiency is more prevalent in males than females [12]. Literature suggests that gluteus medius muscle fatigue is most common in prolonged sitting postures, and this scientific fact could be correlated with the tailor population [13]. LBP is usually estimated with a numerical pain rating scale to assess the pain intensity, and gluteus muscle strength could be assessed by manual muscle testing and a handheld dynamometer. The strength of the gluteus muscle dysfunction could be precisely quantified with a diagnostic surface electromyogram (EMG), and this has been used in this study as the main outcome tool before and after the intervention. Various options of treatment are available to treat the LBP [14-16]. Rest with minimal activity is the first-line solution, followed by drug therapy, electrophysical agents, massage therapy, and exercise therapy [17-19]. Exercise therapy is being prescribed in various forms, such as muscle stretching, proprioceptive neuromuscular facilitation (PNF), and open and closed kinematic exercises.

Even though traditional exercises serve the purpose of treating and preventing low back pain, recent literature suggests that PNF has been effective in treating low back pain and improving lumbopelvic muscle recruitment [20]. The proprioceptive neuromuscular facilitation exercises have the unique characteristic of using spiral movements that stimulate the body's proprioceptive system and foster spontaneous responsiveness, thus being found to be an effective rehabilitation of musculoskeletal and joint disorders [21, 22]. Certain research articles reveal that the use of resistance band exercises with proprioceptive neuromuscular facilitation has been shown to be very effective in improving the muscular strength in the lower extremities [23]. Hence, this study probes to improve gluteus medius muscle recruitment by combining proprioceptive neuromuscular facilitation (PNF) with resistance band exercises to reduce low back pain among tailors.

2. Methods

2.1. Study Design and Setting

This experimental study was proposed to the institutional scientific review board before the commencement of patient recruitment. Institutional Review Board Approval Number: 01/010/2021/ISRB/PGSR/SCPT. The sample size was calculated using Sigma Plot version 14.5 and was based on the prevalence rate with the population percentage of 80% from prior studies and 95% of the confidence interval, taking into account 5% of dropouts.

2.2. Study Participant's Selection Criteria

Tailors from a particular zone of a city were invited in person by the investigators to participate in the study. All the tailors were informed about the study procedure and were asked to enrol in the study based on their willingness. Around 93 tailors showed interest in participating in the study and turned in their willingness letters to the investigators in the hospital and peripheral centres. According to the inclusion criteria, tailors between the age groups of 18 and 59, including both male and female, with a history of prolonged sitting for a period of 5-7 hours, a complaint of low back pain, and a numerical pain rating above 4 on the pain rating scale were included in the study. Hence, 56 tailors were shortlisted for the study. Further, participants with a history of spinal fracture, spondylolisthesis, spinal stenosis, TB spine, acute inflammatory conditions, infectious diseases, or autoimmune disorders were excluded from the study. In total, 48 participants were shortlisted, and these 48 participants were taken for the next phase of the study after getting their informed consent.

2.3. Group Separation and Procedure

The final 48 participants were between the age of 25 and 50, and among these were 18 females and 30 males. By using the concealed envelope method, all the participants were divided randomly into two groups: the control group and the experimental group, with each group consisting of 24 participants. The control group (n = 24) received PNF and other conventional exercises such as lunges, single leg raises with ankle weight (Domyos- iron balls), set up and set down, stretching, and squats. The experimental group (n = 24) received proprioceptive neuromuscular facilitation (PNF) (DF1, DE1, DF2, DE2) exercises combined with an elastic loop resistance band (VPK brand medium resistance band with 20 lbs). Participants in both groups received the above-mentioned treatment for a period of 45-min, rest

period of 2-min between each set. Totally, the session was carried out for 4 weeks, and each week the sessions were prescribed for 5 days.

2.4. Outcome Measures

The outcome measurement tools used in the current study were the numerical pain rating scale (NPRS) to find out the pain score and the surface electromyogram (EMG) to analyse the gluteus medius muscle activation. The EMG was recorded by instructing the participant to do hip abduction and lateral hip rotation, and the muscle activation was recorded in μV. Electrodes were placed at the level of the posterior, middle, and anterior subdivisions of the gluteus medius muscle. The distance between both the iliac crest and the L4-L5 interspaces was employed as the posterior ilium marker.

The NPRS is an 11-point scale with ranges from 0 (no discomfort or pain at all) to 10 (the most excruciating agony conceivable) used to assess the pain in the current study. Pre-test measurement was done on day 1 before the treatment session, and post-test measurement was done after four weeks of treatment. Both the participant and the outcome measure investigators were blinded at this level. All the collected data were tabulated and statistically analysed using paired tests for within groups and independent 't' tests for between groups using SPSS software version 14.3.

Within the group analyses, the experimental group (EG) showed significant improvement ($p < 0.0001$) in the pain intensity (NPRS), which was reduced from 6 ±0.98 to 2.63 ± 1.17. Also, the participants in the control group (CG) showed significant improvement ($p < 0.0001$) in NPRS from 6.29 ± 1 to 4.63 ± 1.28, which indicates that both groups benefited from the intervention as shown in Table 1 and Figure 1. However, when comparing the NPRS between the groups, the experimental group showed a significant improvement ($p < 0.0001$) with mean scores of EG (6.29 ±1) and CG (4.63 ±1.28).

Following a reduction in pain scores, the EMG activation of GM in EG was significantly increased ($p < 0.0001$) from 94.58 ±6.87 to 188.58 ±36.12. Further, the participants in the CG also reported significant increase ($p < 0.0001$) of GM EMG activation from 95.96 ± 6.48 to 119.09 ±15.09. The post-intervention results between the groups show that EMG GM activation was 188.58 ±36.12 in EG who underwent PNF with an elastic loop resistance band, showing a significant improvement ($p < 0.0001$) compared with GM activation of 119.09 ± 15.09 in CG, who was exposed to only PNF training as shown in Table 2 and Figure 2. The results obtained among tailors with low back pain in the present study indicate that PNF training combined with elastic loop resistance band exercise is better at maintaining gluteal medius muscle action, which is important for tailoring.

Table 1. Paired t- test results for NPRS and EMG

	Parameter	Pre-Test		Post Test		Std. Error	T-Value	P Value
		Mean	SD	Mean	SD			
Group A	NPRS	6	0.98	2.63	1.17	0.168	20.0601	< 0.0001
	EMG	94.58	6.87	188.58	36.12	7.571	12.4151	< 0.0001
Group B	NPRS	6.29	1	4.63	1.28	0.155	10.7238	< 0.0001
	EMG	95.96	6.48	119.09	15.09	3.222	7.1791	< 0.0001

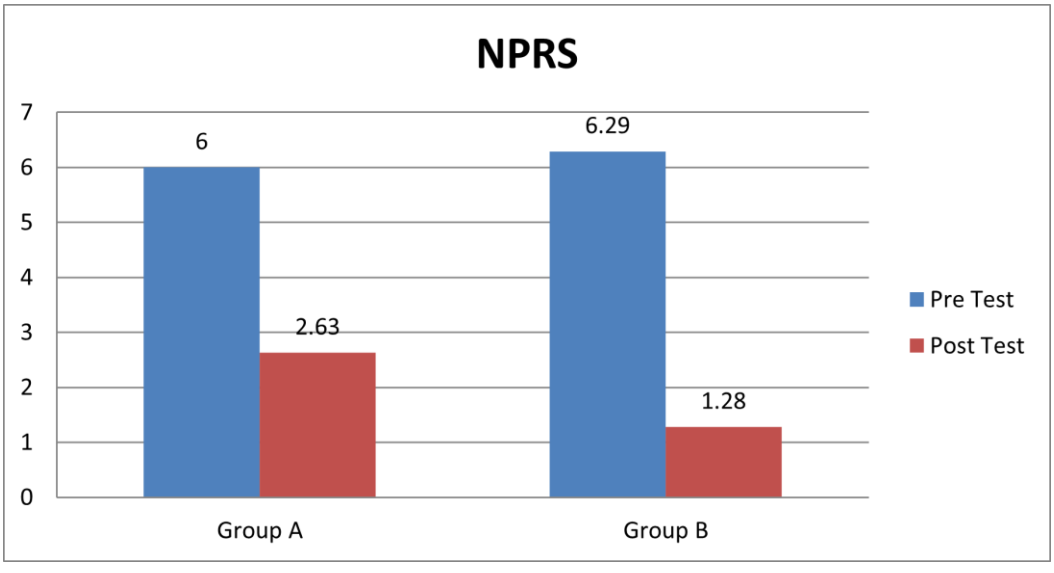

Figure 1. The pain scores for group A and B

Table 2. Independent t- test results for NPRS and EMG

Parameter	Post Test Value				Std. Error	T-Value	P Value
	Group A		Group B				
	Mean	SD	Mean	SD			
NPRS	2.63	1.17	4.63	1.28	0.354	5.6466	< 0.0001
EMG	188.58	36.12	119.09	15.09	8.544	8.1782	< 0.0001

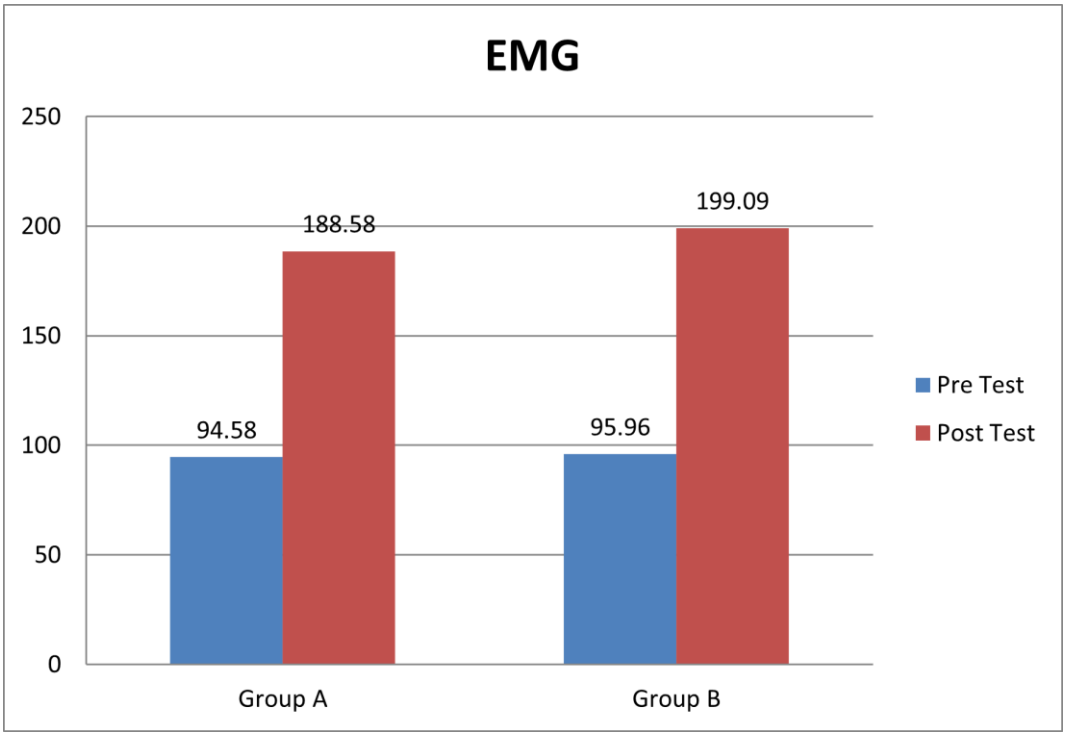

Figure 2. The EMG GM muscle activation for group A and B

3. Discussion

A tailoring job demands prolonged sitting, which loads the lower back and causes low back pain. Research among sitting workers found that the inability to modify one's posture on a frequent basis was linked to a higher risk of LBP [24]. On the other side, Cooper et al. [25] stated that in persons with persistent nonspecific LBP, gluteus medius muscle weakening and discomfort are prevalent symptoms. People with LBP may benefit from better clinical decision-making and treatment results if gluteus medius muscle dysfunction is assessed and treated. As a result of the present study, the PNF technique combined with elastic tube training improved the GM. Add to that, the study by Hamstra-Wright and Bliven [26] suggested that therapeutic practises such as strengthening activities are commonly used and are considered to activate the gluteus medius muscle for non-specific low back pain. However, advise that high-quality research focuses on gluteus medius activation via strengthening programmes in both symptomatic and asymptomatic patients with LBP. When compared to PNF training alone for people with LBP, Ju and Yoo [27] suggested that when paired with other physical therapy procedures, PNF training provides greater therapeutic advantages compared to only PNF training.

Though PNF training has been demonstrated to increase lumbar spine stability in both static and dynamic circumstances by increasing paraspinal muscle activation, Jeong et al. [28] conducted a study over a period of 4 to 8 weeks to assess the effectiveness of gluteus muscle strengthening against lumbar stabilisation activities in a low back pain population. Similarly, the participants in the control group were found to have improved in LBP. However, considering the suggestions from previous studies, combining gluteus muscle strengthening and lumbar stabilisation exercises in chronic low back pain patients might result in a bigger drop in the low back pain disability index and an improvement in lumbar muscle strength and balance ability than merely completing lumbar stabilisation exercises.

4. Limitations and Recommendations

Due to ethical concerns, needle electromyography was not used in this investigation to examine gluteus medius

muscle recruitment. Besides, the cohort study population in this present study was not balanced between male and female genders due to participant voluntary recruitment, which may affect the gender-specific effect of these interventions. Future research could focus on the efficacy of interventions with longer durations and also on other professionals who spend a lot of time in sitting posture.

5. Conclusions

According to the findings, PNF combined with elastic tubing resistance training has shown high significance in the activation of gluteus medius muscle fibre and has been beneficial in reducing low back pain and allowing participants with LBP to recover faster. Based on the result analysis, the PNF with elastic tubing resistance training proposed here might be considered for persons who require non-specific low back discomfort among the tailor population. As a result, it was suggested that this therapy can be used in clinical practice.

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