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Effectiveness of Muscle Energy Technique and Neural Tissue Mobilization on Buttock Pain, Improving Hip Internal Rotation Range of Motion and Functional Disability Among Desk Job Population Having Piriformis Syndrome: A Comparative Study

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Abstract

Background: Prolonged sitting position is the foremost cause of piriformis tightness among desk job population which Eventually leads to piriformis syndrome that results in buttock pain, reduces hip internal rotation and causes low back functional disability. Aim: The aim of the present study was to compare the effectiveness of muscle energy technique and neural tissue mobilization on buttock pain, improving hip internal rotation range of motion and functional disability among desk job population having piriformis syndrome. Methodology: The study was conducted on 45 subjects including both male and female between the age group of 25 to 55 years. The participants were assigned to three groups—A, B, and C—using a convenience sampling method, with 15 individuals in each group. Group A served as the control group, while Groups B and C were served as experimental groups. The outcome measures were Visual Analogue Scale (VAS) for pain, Universal Goniometer (360º) for hip internal rotation range of motion and Oswestry Disability Index (ODI) for low back functional disability. Results: Statistical analysis revealed that by the 10th day, all three groups (group A, group B, and group C) showed significant improvements in pain reduction, functional disability, and hip internal rotation range of motion However, group C demonstrated a highly significant improvement compared to group A and group B. Conclusions: The present study concludes that neural tissue mobilization was more effective in reducing buttock pain, improving hip internal rotation range of motion and decreasing functional disability than muscle energy technique among desk job population having piriformis syndrome.

Keywords: Piriformis Syndrome, Muscle Energy Technique, Neural Tissue Mobilization.

1. Introduction

Piriformis syndrome is a neuromuscular condition that is characterized by pain in hip, buttock and may even refer to the back of thigh.[1] Piriformis syndrome is also referred to as 'deep gluteal syndrome', 'pelvic outlet syndrome' or 'pseudo- sciatica'.[2] It was first described by Yeoman in 1928 as 'sacroiliac periarthritis'.[3] The term 'piriformis syndrome' was introduced by Daniel R. Robinson in 1947. [4] It occurs when piriformis muscle compresses the sciatic nerve which results in numbness, shooting or burning, tingling sensations aching down the back of the leg.[5] The cause of piriformis syndrome may involve shortening, spasm, hypertrophy or inflammation of piriformis muscle.[1] Piriformis syndrome comprises of mainly two types: primary piriformis syndrome and secondary piriformis syndrome. Primary piriformis syndrome has an anatomic cause such as split piriformis muscle or split sciatic nerve. Secondary piriformis syndrome occurs due to local ischemia, microtrauma or macro trauma. Microtrauma represented by overuse of piriformis muscle, prolonged sitting or standing, direct compression e.g.: Wallet neuritis. Macro trauma represented by falling on hip or buttocks.[6] Prolonged sitting in sedentary office jobs can lead to adaptive shortening and tightness in hip muscles (hamstrings, iliopsoas, and piriformis), contributing to low back pain and impairing daily activities.[7] Piriformis muscle possesses predominance of type 1 fibres which has ability to tighten or shorten the piriformis muscle when it is inadequately compressed or stressed. when piriformis muscle is tight, it becomes shortened, its diameter increases that creates pressure on sciatic nerve and irritates the sciatic nerve which is found in 80% of population.[8] Irritated sciatic nerve further leads to altering gait patterns such as limping or antalgic gait.[9] Piriformis syndrome affects individuals across all professions and is most commonly seen in the fourth and fifth decades of life.[10,11] Its prevalence ranges from 12.2% to 27%, with an estimated 2.4 million cases annually. The condition can cause moderate to severe disability and is often worsened by poor sitting habits, such as prolonged, cross-legged, or hard-surface sitting.[12,13] It is more common in women, with a male-to-female ratio of 1:6. Additionally, piriformis syndrome is associated with low back pain in 5% to 36% of cases.[1,14] Physical examination is key in diagnosing piriformis syndrome, with special tests like the Flexion Abduction Internal Rotation (FAIR), Beatty, Freiberg, and Pace tests being the most reliable and beneficial according to the literature.[15] Physiotherapy management plays an important role in reducing pain and improving range of motion among subjects with piriformis syndrome. It comprises of electrotherapy and manual therapy interventions. Electrotherapy includes- Moist hot pack, Transcutaneous Electrical Nerve Stimulation (TENS), Ultrasound therapy etc. and manual therapy includes interventions such as Static stretching of piriformis muscle, Muscle energy techniques (MET), Myofascial Release (MFR), Mulligan mobilization, Deep friction massage and Neural tissue mobilization etc. Only Few studies showed that Muscle Energy Technique and Neural Tissue Mobilization has been proved separately to be effective in piriformis syndrome. Due to scarcity of literature, it has been observed that comparison of both the techniques have not much explored among subjects with piriformis syndrome.

Muscle Energy Technique (MET) was developed by Fred Mitchell in 1948. [16] Muscle energy techniques are a type of soft tissue osteopathic manipulative method which involves isometric and or isotonic contractions that are precisely directed, controlled and patient initiated. It works on musculoskeletal system that helps to improve flexibility, range of motion, strengthen the weakened muscles and decreases muscle tension. It consists of two principles: Post Isometric Relaxation (PIR), Reciprocal Inhibition (RI).[17] Post Isometric Relaxation is a technique developed by Karel Lewitt.[18] Post Isometric Relaxation (PIR) is used to lengthen the hypertonic muscle by performing isometric contraction of the agonist or same muscle which reduces muscle tone due to activation of stretch receptors mainly present at Golgi tendon organs

(GTO's). These receptors provide relaxation after isometric contraction by inhibiting further muscular contractions. while Reciprocal Inhibition (RI) involves relaxation of the antagonist or opposite muscle when agonist muscle is isometrically contracted. This occurs due to presence of neurological at Golgi tendon organs (GTO's) and hence reduces the muscle tone of antagonist.[17]

Neural Tissue Mobilization is a manipulative technique by which neural tissues are moved and stretched either by movement relative to their adjacent tissues or by tension development. This technique has been demonstrated to produce mechanical effects by including- Tensioning and Sliding techniques. Tensioning is the first mechanical event in neural structures which involves generation of tension and lengthening of nerves by elongation. Sliding is another event which involves movement of neural structures relative to their adjacent tissues.[9,19,20,21] Neural tissue mobilization helps to improve intra neural mobility, intra neural blood flow, axoplasmic blood flow, mechano-sensitivity by decreasing pain, inflammation and intra neural oedema, improving range of motion and reducing disability.[5,20]

2. Subjects & Methodology

2.1 Study Design: Quasi-experimental study comparative in nature. Convenient sampling was done. The study was performed in the OPD of D.A.V Institute of Physiotherapy and Rehabilitation, Jalandhar. The duration of study was one and half years. A total of 45 subjects (male and female) were enrolled for the study and divided into three groups- group A, group B and group C. Group A was Control group, Group B and Group C were Experimental groups (1 and 2). Minimum of 15 subjects were allocated in each group.

2.2 Procedure

All the subjects were selected based on the following inclusion and exclusion criteria. A written informed consent was obtained from all the subjects and were assessed for pain level with Visual Analogue Scale (VAS), hip internal rotation range of motion (ROM) with universal goniometer (360°) and functional disability with Oswestry Disability Index (ODI). Group A (Control group) subjects were treated with moist hot pack, high transcutaneous electrical nerve stimulation (high TENS), Continuous ultrasound therapy and static stretching of piriformis muscle. Group B (Experimental group) subjects were treated with moist hot pack, high transcutaneous electrical nerve stimulation (high TENS), Continuous ultrasound therapy and Muscle Energy Technique (Post isometric relaxation and Reciprocal Inhibition) for piriformis muscle. Group C (Experimental group) subjects were treated with moist hot pack, high transcutaneous electrical nerve stimulation (high TENS), Continuous ultrasound therapy and Neural Tissue Mobilization for sciatic nerve. A moist hot pack, high TENS (80–120 Hz) were applied to the gluteal region targeting the piriformis for 15 minutes and continuous ultrasound therapy (2.5 W/cm²) were applied to the buttock area targeting the piriformis for 5 minutes respectively. A total of 10 treatment sessions were given to each group, 5 sessions per week for 2 consecutive weeks.

2.3 Control Group (Static stretching of piriformis muscle)

Position of the subject- The subject was in supine lying position, with the treated leg is placed into flexion at hip and knee, so that foot rests on the couch lateral to contralateral knee (the leg on the side to be treated is crossed over the another). Position of the therapist- Standing while places one hand on the contra-lateral anterior superior iliac spine (ASIS) to prevent pelvic motion while other hand placed against the lateral flexed knee. Then adduction was performed by therapist to stretch the piriformis muscle. Duration of piriformis stretching was 30 seconds hold with 3 repetitions.

Figure:1 Static stretching of piriformis muscle

2.4 Experimental Group 1 (Muscle Energy Technique)

Post isometric relaxation- The therapist begins the technique by placing the subject's shortened or tight muscle in a stretched position passively. The subject was performed active isometric contraction against minimal resistance to relax the shortened or tight muscle. The therapist force was the same as the subject force. Initial effort is approximately 20% of patient strength. Position of the subject- The subject was in supine lying position, with the treated leg is placed into flexion at hip and knee, so that foot rests on the couch lateral to contralateral knee (the leg on the side to be treated is crossed over the another). Position of the therapist- Standing while places one hand on the contra-lateral anterior superior iliac spine (ASIS) to prevent pelvic motion while other hand placed against the lateral flexed knee. Then resisted abduction was performed to contract piriformis muscle. The starting position was the 1st sign of resistance towards the end range. Duration of contraction was 7-10 seconds with 3 repetitions.

Figure: 2 Post isometric relaxation of piriformis muscle

Reciprocal inhibition- The therapist begins the technique by placing the subject's shortened or tight muscle in a stretched position passively. The subject was performed active isometric contraction against minimal resistance to relax the shortened or tight muscle. The therapist force was the same as the subject force. Initial effort is approximately 20% of patient strength. Position of the subject- The subject was in supine lying position, with the treated leg is placed into flexion at hip and knee, so that foot rest on the couch lateral to contralateral knee (the leg on the side to be treated is crossed over the other). Position of the

therapist- Standing while places one hand on the contra-lateral anterior superior iliac spine (ASIS) to prevent pelvic motion while other hand placed against the medial flexed knee. Then resisted adduction was performed to contract antagonist muscle. The starting position was the 1st sign of resistance towards the end range. Duration of contraction was 7-10 seconds with 3 repetitions.

Figure: 3 Reciprocal inhibition of piriformis muscle

2.5 Experimental Group 2 (Neural Tissue Mobilization of Sciatic nerve)
Position of the subject- The subject was in supine lying position. Position of the therapist- Standing while place one hand at ankle joint and other hand over posterior aspect of knee joint. The straight leg raise (SLR) of subject's affected leg was performed passively by therapist to induce longitudinal tension. The subject hip was in flexion, knee in extension and ankle in dorsiflexion. Since the sciatic nerve is completely stretched at 70^{o} unilateral SLR causes tension on sciatic nerve and piriformis muscle (buttock area). Then the therapist introduces additional traction into the proximal aspect of sciatic nerve and hip adduction and internal rotation added to SLR. Duration of neural tissue mobilization was 3 repetitions 30 seconds hold and 1 minute rest.

Figure: 4 Neural Tissue Mobilization of sciatic nerve

3. Results

This study aimed to compare the effectiveness of Muscle Energy Technique and Neural Tissue Mobilization on pain, improving hip internal rotation range of motion and functional disability among

desk job population having piriformis syndrome. The statistical analysis was performed using SPSS software version 18.0. Level of significance 0.05 was used to determine the statistical significance. Both within Group and between Group analysis was done to analyse dependent variables [Score of Visual Analogue Scale (VAS) for pain, Hip Internal Rotation Range of motion, Score of Oswestry Disability Index (ODI) for functional disability]. One way ANOVA and Post Hoc analysis by Tukey's method was used for the comparison of three groups. The data were collected on Day 1st (before the intervention), Day 5th (after the intervention), and Day 10 th (after the intervention).

Statistical analysis between the Group showed that there was a statistically significant difference between all three groups- Control group (Group A), Muscle Energy Technique (Group B) and Neural Tissue Mobilization (Group C) in terms of pain, range of motion and functional disability among desk job population having piriformis syndrome. Further on comparison of all three groups- Control group (Group A), Muscle Energy Technique (Group B) and Neural Tissue Mobilization (Group C), elicited that Neural Tissue Mobilization (Group C) was better than Muscle Energy Technique (Group B) and Control group (Group A) in decreasing pain, improving internal rotation Range of motion and reducing functional disability.

Table:1 Comparison of mean for VAS between the group A, group B, and group C

.	**VAS**								
ANOVA	DAY1			DAY 5			DAY10		
	Group A	Group B	Group C	Group A	Group B	Group C	Group A	Group B	Group C
Mean	7.00	7.13	7.07	5.73	5.80	5.33	4.67	4.27	3.73
S.D.	0.756	0.640	0.458	1.033	0.676	0.724	1.113	0.594	0.799
Number	15	15	15	15	15	15	15	15	15
Maximum	8	8	8	7	7	7	6	5	5
Minimum	6	6	6	4	5	4	3	3	3
Range	2	2	2	3	2	3	3	2	2
F test	0.168			1.400			4.472		
Table Value at 0.05	3.220			3.220			3.220		
P value	0.846			0.258			0.017		
Result	Not Significant			Not Significant			Significant		

Tukey's method for Pairwise comparison Mean Difference & Result>												
		A				A				A		
	B	0.14 NSig	B	B		0.07 NSig	B	B		0.4 NSig	B	
	C	0.07	0.07	C		0.4	0.47	C		0.94	0.54	

NSig	NSig		NSig	NSig		Sig	NSig	

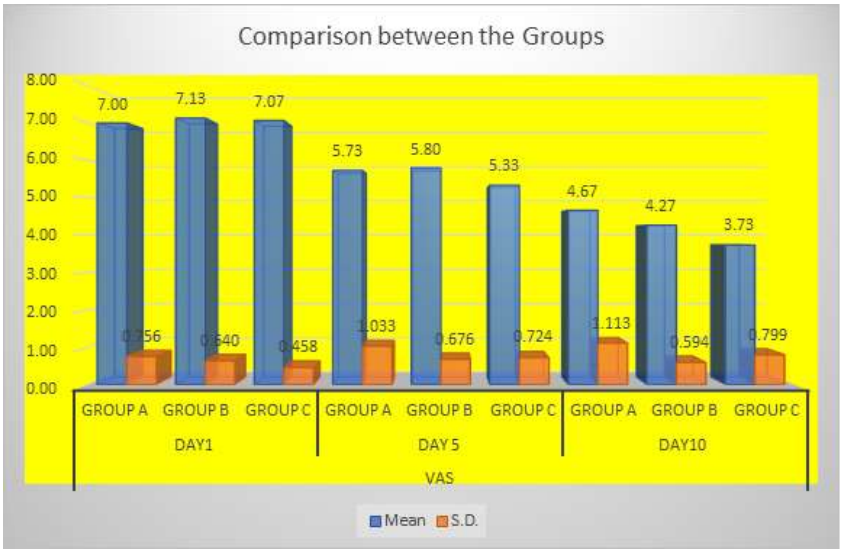

Figure: 5 Comparison of mean for VAS between the group A, group B, and group C

Visual Analogue Scale was used to assess pain intensity on Day 1, Day 5, and Day 10. On Day 1, there was no significant difference between the groups with an F-test value of 0.168 and a p-value of 0.846. The mean VAS scores were similar across all groups: 7.00 for Group A, 7.13 for Group B, and 7.07 for Group C. This suggests that the participants in all groups started with comparable levels of pain. By Day 5, although the mean VAS scores decreased for all groups (5.73 for Group A, 5.80 for Group B, and 5.33 for Group C), there was still no significant difference between the groups. The F-test value of 1.400 and p-value of 0.258 confirm this. Therefore, pain reduction at this stage was similar across all groups. On Day 10, however, a significant difference emerged with an F-test value of 4.472 and a p-value of 0.017. The pain levels continued to decrease, with Group C showing the most improvement (mean VAS score of 3.73), followed by Group B (4.27) and Group A (4.67). The post-hoc analysis (Tukey's test) showed a significant difference between Group A and Group C, indicating that the intervention for Group C was more effective in reducing pain intensity by the 10th day. Overall, Group C demonstrated the most effective pain reduction over the study period, particularly by the 10th day.

Table: 2 Comparison of mean for Internal Rotation between the group A, group B, and group C.

.	**INTERNAL ROTATION**								
ANOVA	DAY1			DAY5			DAY10		
	Group A	Group B	Group C	Group A	Group B	Group C	Group A	Group B	Group C
Mean	26.33	26.87	26.07	27.53	29.47	30.87	29.60	32.67	33.60
S.D.	1.447	1.457	2.987	1.407	1.407	2.446	1.352	2.024	2.444
Number	15	15	15	15	15	15	15	15	15
Maximum	28	28	30	30	32	35	32	36	38
Minimum	25	25	22	25	28	25	28	30	28

Range	3	3	8	5	4	10	4	6	10
F test	0.568			12.679			16.567		
Table Value at 0.05	3.220			3.220			3.220		
P value	0.571			0.000			0.000		
Result	Not Significant			Significant			Significant		

Tukey's method for Pairwise comparison									
		A			A			A	
Mean Difference & Result>	B	0.54 NSig	B	B	1.94 Sig	B	B	3.07 Sig	B
	C	0.27N Sig	0.81 NSig	C	3.34 Sig	1.4 NSig	C	4 Sig	0.94 NSig

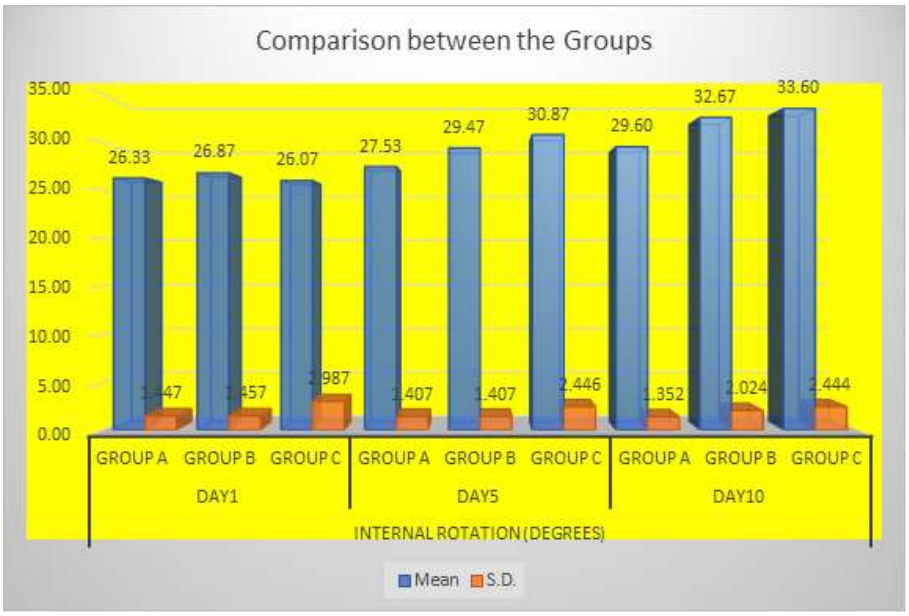

Figure: 6 Comparison of mean for Internal Rotation between the group A, group B, and group C.

Internal Rotation was measured on Day 1, Day 5, and Day 10. On Day 1, there was no significant difference between the groups with an F-test value of 0.568 and a p-value of 0.571. The mean degrees of internal rotation were 26.33 for Group A, 26.87 for Group B, and 26.07 for Group C. This indicates that the baseline levels of internal rotation were nearly identical across groups. By Day 5, a significant difference was observed with an F-test value of 12.679 and a p value of <0.001. Group C showed the highest improvement in internal rotation (30.87°), followed by Group B (29.47°) and Group A (27.53 degrees). The post hoc analysis showed significant differences between Group A and Group C as well as Group B and Group C, indicating a higher degree of improvement in Group C. By Day 10, the differences

became more pronounced with an F-test value of 16.567 and a p-value of <0.001. Group C again showed the highest improvement (33.60°), followed by Group B (32.67 degrees) and Group A (29.60 degrees). The Tukey's test showed that the improvement in Group C was significantly better than in Groups A and B. Overall, Group C demonstrated the most improvement in internal rotation, with Group B also showing considerable progress. Group A showed the least improvement.

Table: 3 Comparison of mean for ODI between the group A, group B, and group C

.	**ODI**								
ANOVA	DAY1			DAY5			DAY10		
	Group A	Group B	Group C	Group A	Group B	Group C	Group A	Group B	Group C
Mean	46.47	48.27	43.33	40.33	35.27	27.47	32.00	23.27	15.67
S.D.	5.630	6.787	8.235	4.981	6.442	5.502	5.757	6.193	4.419
Number	15	15	15	15	15	15	15	15	15
Maximum	60	62	56	53	44	38	42	31	23
Minimum	35	40	31	33	24	17	23	10	9
Range	25	22	25	20	20	21	19	21	14
F test	1.927			19.576			33.027		
Table Value at 0.05	3.220			3.220			3.220		
P value	0.158			0.000			0.000		
Result	Not Significant			Significant			Significant		

Tukey's method for Pairwise comparison Mean Difference & Result>										
		A			A			A		
	B	1.8 NSig	B	B	5.07 Sig	B	B	8.74 Sig	B	
	C	3.14 NSig	4.94 NSig	C	12.87 Sig	7.8 Sig	C	16.34 Sig	7.6 Sig	

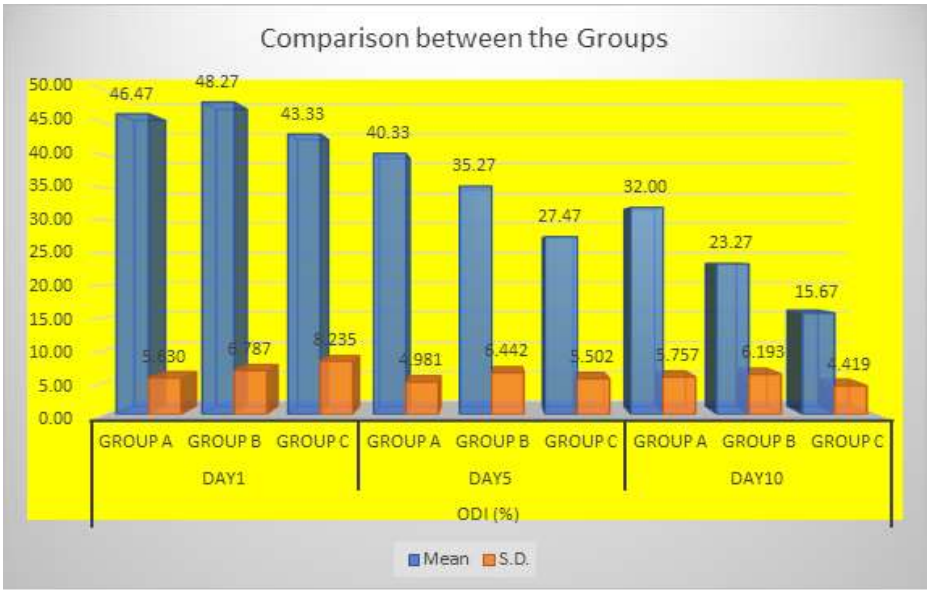

Figure: 7 Comparison of mean for ODI between the group A, group B, and group C

Oswestry Disability Index was assessed on Day 1, Day 5, and Day 10. On Day 1, there was no significant difference between the groups with an F-test value of 1.927 and a p-value of 0.158. The mean ODI scores were 46.47 for Group A, 48.27 for Group B, and 43.33 for Group C. This indicates that the initial disability levels were relatively similar across the groups. By Day 5, a highly significant difference was observed with an F-test value of 19.576 and a p-value of <0.001. Group C showed the most significant reduction in ODI score (27.47), followed by Group B (35.27) and Group A (40.33). The Tukey's test indicated significant differences between Group C and the other groups, suggesting a superior improvement in reducing disability. By Day 10, the differences between the groups were even more pronounced, with an F test value of 33.027 and a p-value of <0.001. Group C continued to demonstrate the most improvement (ODI score of 15.67), followed by Group B (23.27) and Group A (32.00). The post-hoc analysis showed that the improvement in Group C was significantly better than in both Groups A and B. Overall, Group C demonstrated the most effective reduction in disability over the study period, particularly by the 10th day. Group B showed moderate improvement, while Group A displayed the least progress.

4. Discussion

The purpose of this study was to compare the effectiveness of Muscle Energy Technique (MET) and Neural Tissue Mobilization (NTM) on pain, hip internal rotation range of motion (ROM), and functional disability among the desk job population suffering from piriformis syndrome. The findings of the present study are supported by various previous studies in the literature. A study by Ron Clijsen et al. (2022)[22] investigated the application of local heat in managing acute and chronic musculoskeletal disorders. The results indicated that heat application via hot packs is effective in reducing pain, tissue stiffness, and disability while enhancing physical function, ROM, muscular strength, and overall quality of life. Similarly, a review by Carol G.T. Vance et al. (2022)[23] assessed the efficacy of Transcutaneous Electrical Nerve Stimulation (TENS) in pain management. The findings demonstrated that TENS is effective for both acute and chronic musculoskeletal and neuromuscular pain conditions, supporting its utility in clinical practice. Emmanuel S. Papadopoulos (2020)[24] conducted a study to evaluate the role of ultrasound therapy in musculoskeletal soft tissue pain. The results concluded that ultrasound is effective in alleviating

pain, muscle spasm, and stiffness, further validating its therapeutic application. A study by Quratulain Saeed (2017)[25] examined the outcomes of a specific piriformis stretching technique in females with piriformis syndrome. The combination of stretching, hydrocollator packs, and ultrasound therapy was found to be particularly effective in reducing pain and enhancing ROM. In a comparative study by Gopal Nambi Bose et al. (2018)[1], the effects of reciprocal inhibition and post-isometric relaxation techniques in piriformis syndrome were analyzed. Both techniques yielded significant improvements; however, post-isometric relaxation was found to be more effective in reducing pain, improving hip ROM, and decreasing functional disability. Lastly, a study by Rahul Krishnan Kutty et al. (2014)[20] evaluated the therapeutic efficacy of neural mobilization in patients with piriformis syndrome. Their results concluded that Neural Tissue Mobilization, when combined with conventional physical therapy, significantly decreased pain intensity and improved hip ROM.

5. Future Scope

The study could be replicated with a larger sample size for more generalizable results. Future research may also include long-term follow-ups to assess lasting effects. Conducting the study over an extended period and involving participants from various professions could further enhance its scope and applicability.

6. Conclusions

Statistical analysis showed that by the 10th day, all three groups—Group A, Group B, and Group C—experienced notable reductions in pain and functional disability, along with improvements in hip internal rotation range of motion. However, Group C demonstrated significantly greater improvements compared to the other two groups. These findings suggest that Neural Tissue Mobilization is more effective than Muscle Energy Technique in alleviating buttock pain, enhancing hip mobility, and reducing functional limitations in individuals with piriformis syndrome who work desk jobs.

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