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Research Article

Efficacy of Single Stretching Session of Iliopsoas using PNF Versus MET on Low Back Pain in Patients with Lumbar Hyper-Lordosis

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ABSTRACT

Low back pain (LBP) is among one of the most common causes for which an individual seeks treatment at physiotherapy. There are numerous aetiologies of low back pain, but narrowing it to mechanical causes brings pelvic tilting to light.

In this study, we focus on the LPB related to anterior pelvic tilting, and as it occurs due to the tightness in the iliopsoas muscle the key to relieving LBP in such conditions is to stretch that muscle optimally. We have compared two stretching approaches for this purpose, they are proprioceptive neuromuscular facilitation (PNF) and muscle energy technique (MET), however many other stretching methods exist but these two methods have been shown highly reliable in the evidence. The people from 18-60 years of age suffering from LBP, exaggerated lumbar lordosis, and who matched the criterion for inclusion were chosen for the study. A group and B group were constructed. Participants in group A were managed by PNF and conventional physiotherapy and those in B were managed by MET and conventional physiotherapy. The same pre and post-test were carried out for each group which was the Numerical Pain Rating Scale (NPRS) used for determining intensity of pain, hip joint extension range of motion (ROM) was taken by universal goniometer for analysing iliopsoas flexibility and lumbosacral angle (LSA) was taken through an X-ray in supine for identifying lumbar lordosis angle. Significant differences were found in pain, hip extension range of motion, and lumbar lordosis angle between intervention (PNF) and control (MET) groups ($P<0.0001$), and much more difference was noted between pre- and post-test for intervention group than for control group.

The present study of 100 participants, showed that both the techniques PNF and MET are significantly effective for stretching the tight iliopsoas. A comparison of both techniques showed that the PNF group had benefited much more than the MET group.

Keywords: Low back pain, Lumbar hyper-lordosis, Anterior pelvic tilting, PNF, MET.

INTRODUCTION

Individuals who are in an activity flag frequently experience low back discomfort, which interferes with their occupations and daily activities [1]. There are several causes of low back pain (LBP) which can be specific or non-specific; however, this study focuses on one of the specific causes i.e., the link between LBP and iliopsoas tightness, as well as the most efficient stretching strategy for reducing the pain severity within a single session.

The iliopsoas muscle is the most powerful hip joint flexor and is known to link the spine to the lower extremities. It is a deep muscle made up of the iliacus and psoas major [2]. An inactive lifestyle can lead this muscle to

tighten, reduce the joint range of motion, and diminish mobility, all of which can disturb an individual's daily activities. People whose employment requires them to sit for extended periods during the day, such as computer professionals or desk workers, are more prone to undergo adaptive changes that shorten these muscles because they are not usually stretched during everyday activities [3].

The iliopsoas muscle is crucial for pelvic mobility and stability, it has been established that it is directly associated to back pain because of the short length of iliopsoas, the spine hyper-lordoses and the pelvis tilts anteriorly, putting strain on erector spinae and all other spinal muscles [4]. Both innominate rotates anteriorly in anterior pelvic tilting, which can be caused by several circumstances but is most commonly caused by an oversupply of muscles pulling on the lumbar and/or pelvis regions. The lower cross syndrome refers to this type of postural distortion pattern that affects the pelvic and low back muscles [5]. It is also described as the reciprocal inhibition of the gluteus maximus resulting from iliopsoas tightness [6]. In addition to the iliopsoas and erector spinae, the rectus femoris and quadratus lumborum are essential postural muscles that seem hypertonic in the pelvic and lower back regions. When these muscles become too tight, they cause anterior pelvic tilt and lumbar lordosis. This group is opposed by the phasic muscles of the pelvis and abdomen comprising the gluteus medius, gluteus maximus, and rectus abdominis. Phasic muscles might deteriorate as a result of inactivity. Sedentary lifestyle encourages postural muscle overuse at the expense of phasic muscle [7].

People with iliopsoas tightness have significantly decreased iliopsoas strength, restricted hip extension range of motion (ROM), increased pelvic tilting, and lumbar lordosis as compared to stable individuals [8]. A gain in muscle flexibility and a tendency for the pelvis to retrovert and neutralise was observed when this muscle was stretched in supine lying with semi-flexion of the knees [9]. Proprioceptive neuromuscular facilitation (PNF) muscle energy method (MET) stretching (ballistic, static), soft tissue mobilization, Yoga (asanas such as Virabhadrasana, Sarvangasana, Navasana), and myofascial release are all used to alleviate iliopsoas tension.

Aim and purpose of the study

This study's aim was to identify the most effective single-session iliopsoas stretching technique amongst the hold-relax PNF technique and post isometric relaxation MET for relieving the low back pain. It is a single session study because the pain can be relieved in a single session but it can recur, and once we find out the better technique, one can freely administrator it whenever pain recurs. Since the purpose of comparison between PNF stretching technique and MET stretching technique was to find out which one is superior to other in a particular situation, it will also help to get a base and research further in future but with regards to different muscles and conditions [9].

Research hypothesis

Null hypothesis

There will be no or less significant difference in reduction of pain after hold relax PNF technique compared to post isometric relaxation MET in patients with exaggerated lumbar lordosis [10].

Alternate hypothesis

More significant reduction in LBP will be seen after hold relax PNF technique compared post isometric relaxation MET in patients with exaggerated lumbar lordosis [11].

MATERIAL AND METHODS

The study was carried out in Neuro-Physiotherapy OPD and the participants were recruited from the orthopaedic and neuro physiotherapy OPDs of AVBR Hospital Sawang (M), Wardha, Maharashtra once the approval has been gained from the Institutional Ethics Committee of DMIMS (DU) (Ethical permission number: DMIMS(DU)/IEC/2021/379). The informed consent was obtained, subjective information was gathered and an initial assessment was done to find out the eligibility of the individuals in accordance with exclusion & inclusion criteria mentioned below.

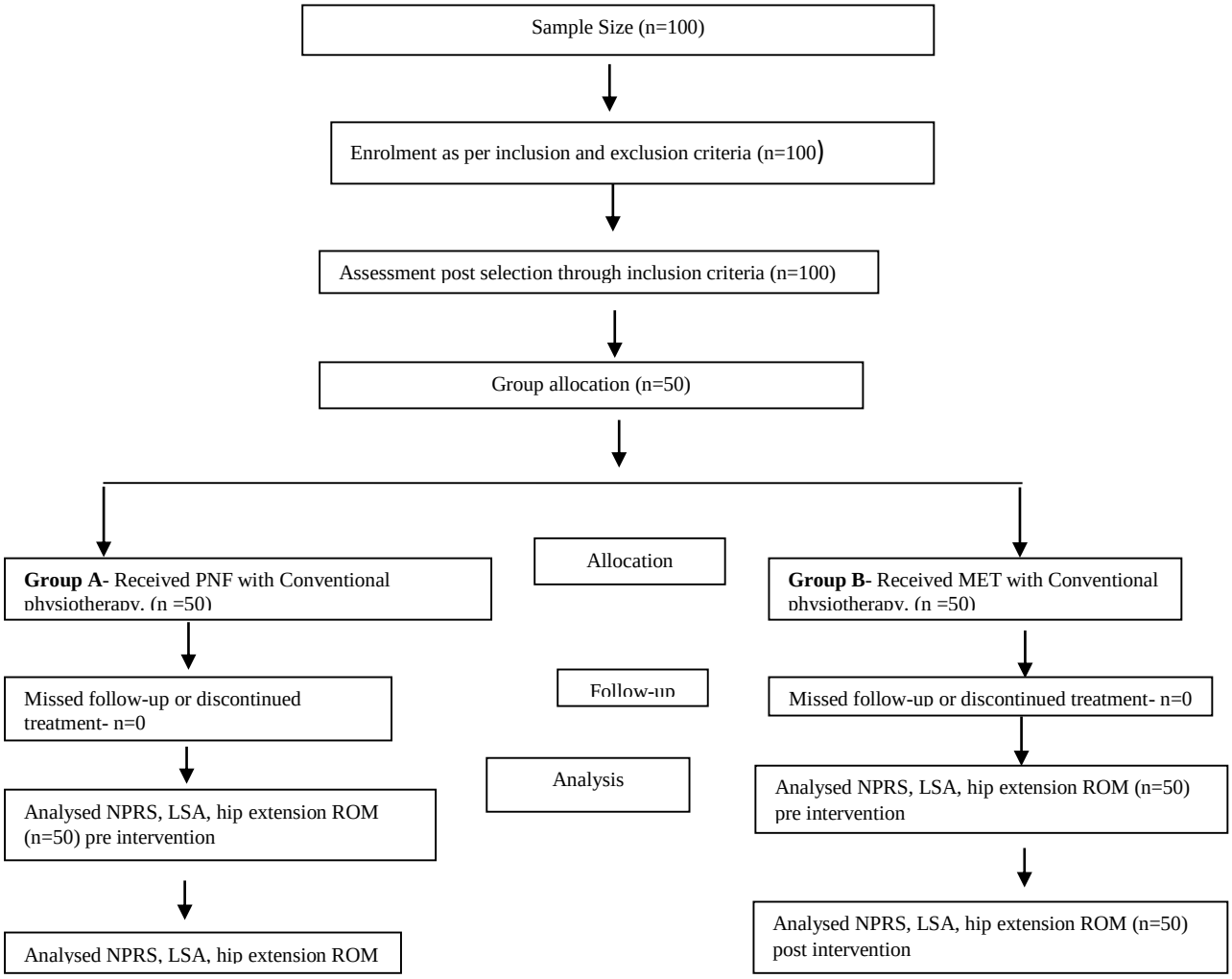
Inclusion criteria was, either gender between 20-65 years of age; those who had LBP (Numerical Pain Rating Scale >4); hyper-lordosis of the lumbar spine (Lumbo-Sacral angle >40°); was able to comprehend and follow directions; was ready to take part in the research and able to fill the outcome measures.

Exclusion criteria includes people under the age of 20 and those over the age of 65; those who had LBP

(Numerical Pain Rating Scale <4); hyper-lordosis of the lumbar spine (Lumbo-Sacral angle <40°); those who had complaints of radiculopathies with or without neurological deficits; those who have been diagnosed with degeneration of the spine, malignancies of the spine, pregnant, operated in the lumbar or thoracic spine, have anatomical deformities of spine or chest wall, currently enrolled in another research trial for a similar illness and have non-specific LBP.

The eligible participants were the enlightened about the study's aims & methodologies. The participants were randomised using Simple Random sampling and assigned to Group A or Group B using the SNOSE method. Randomisation and allocation were done by the primary researcher, who was an intern in physiotherapy department. The study schedule of enrolment, intervention and assessment of study was done as recommended by standard protocol items: a recommendation for intervention trials (spirit, 2013) The flowchart of the study procedure is depicted in figure 1.

Figure 1: flowchart of the study procedure



Outcome measures

The following outcome measures were assessed before and after the intervention by a physiotherapy undergraduate student who was aware of the study but blinded to the intervention.

Numerical pain rating scale (NPRS): The NPRS helped to quantify the intensity of pain that the patient was experiencing in his low back on a paper before intervention and the improvement or exacerbation after the intervention. According to a study, a 2-point shift on the NPRS implies a clinically significant change that exceeds the measurement error boundaries [2]. Lumbosacral angle (LSA): We measured the LSA through an X-ray in supine (by an angle which was made by a line passing through superior aspect of S1 vertebra and a horizontal line before and after the intervention for analysing the difference in the lumbar lordosis as it has been stated gold standard in some studies Previous studies have suggested the normal lordosis angle as 30° and hyper-lordosis angles for >40° (20). Lumbar

lordosis angle ang lumbosacral angle has been used interchangeably in the text below.

Goniometry: range of motion of a joint was measured by a goniometer in degrees, here it was used to measure the degrees of extension at the hip before and after the intervention. Traditional manual goniometers, have been found to be valid for confident use in the clinics for longitudinal examinations [13].

Intervention

NPRS, LSA and bilateral Hip extension ROM was taken before and after intervention. Group A subjects were given PNF and conventional physiotherapy while group B subjects were given MET and conventional physiotherapy. Each technique was repeated thrice and conventional physiotherapy in both groups was given in the form of hot pack before the treatment over the low back region for ten minutes [14].

Group A

Participants in this group had their iliopsoas stretched bilaterally using PNF 3 times in a single session, with rest in between each repetition along with the basic conventional physiotherapy. The lower extremity PNF pattern was performed bilaterally using D1 extension and flexion pattern which was extension-abduction-internal rotation and flexion-adduction-external rotation, the pattern was performed using hold-relax PNF technique [15].

Patient and therapist's position (figure 2): The patient was positioned supine at the couch's edge on the treatment leg's side, with hip in flexion-adduction-external rotation and knee extension. The therapist stood beside the extended leg, facing the patient, and adjusted his position in response to the limb's motions. The therapist's focus was on his proximal and distal grips, stretches, orders, resistance, and timing [16].

Hold-relax method that was used in this D1 movement pattern is as follows: The therapist would request an isometric contraction of the iliopsoas with concentration on rotation, which was held for 10 seconds. The resistance would be gradually raised. Neither the patient nor the therapist would intend to move. The patient will be asked to relax after holding the contraction. Both the patient & the therapist would gradually become more relaxed. The limb would then be taken limit of range that has newly been achieved either passively or actively and held for another 10 seconds [17].

Figure 2: Start (left) and end (right) position for PNF stretching technique

Group B

This group received iliopsoas MET stretching bilaterally using post isometric relaxation technique, 3 times in a single session with rest between each repetition along with the basic conventional physiotherapy.

Patient and therapist's position (figure 3): The patient was placed in the supine test position, buttocks at the edge of the couch and opposite hip and knee flexed totally & held in place by patient's hand. The therapist would stand at the patient's foot end, facing the treatment leg, allowing the non-treatment leg to dangle freely.

Post isometric relaxation used is as follows: The therapist would ask the patient to inhale and take the treatment leg towards her while therapist resists it for 10 seconds. On exhalation, the leg would be moved slightly beyond the limitation, with a little amount of painless pressure applied towards the floor, and kept there for 30 seconds after the isometric contraction. Appropriate breathing instructions were given, such as inhaling when contracting, holding the breath while contracting, and exhaling when the contraction phase was over and relaxation began [18].

Figure 3: Start (left) and end (right) position for MET stretching technique

Criteria for discontinuing the intervention

The intervention would be discontinued if the patient's back pain got extreme with the intervention or he decided to quit amidst the intervention.

STATISTICAL ANALYSIS AND RESULT

Statistical analysis was done by using descriptive and inferential statistics using chisquare test, student's paired and unpaired t test and software used in the analysis were SPSS 27.0 version and GraphPad Prism 7.0 version and $p<0.05$ is considered as level of significance. To compare group A (PNF) and B (MET) to find out a successful approach for reducing LBP, lumbar lordosis angle, and enhancing iliopsoas flexibility, the student t-test was used. To compare Pre and Post scores within group A and B, paired t test was used. To compare Post mean difference scores between groups A and group B, unpaired t test was used.

Subject characteristics: Table (1) shows the subject characteristics of both groups. There was very less significant difference between both groups in the mean age ($P<0.83$) and sex ($P<0.42$).

Table 1: Participant characteristics

Baseline/ subject characteristics	Group A	Group B	P-value
Age in years	37.72±11.84	37.20±12.39	0.83, NS
Gender: Male	19(38%)	24(48%)	0.41, NS
Gender: Female	31(62%)	26(52%)	

Statistical evidence for the effect of treatment on the low back pain, LSA or lumbar lordosis angle and extension ROM of bilateral hip joint is presented in table 2 and graph 1, 2, 3 and 4 respectively. Table 2 displays statistical analysis for measured variables and also the significant value of comparison in each group between before and after intervention. Figure 4 and 5 shows difference in the LSA pre and post PNF and MET interventions respectively.

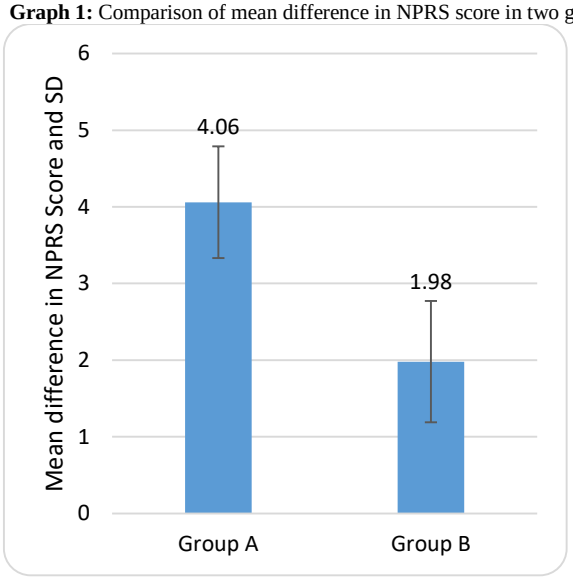
Within group comparison: There was a significant decrease in pain, LSA and right and left hip extension ROM post treatment compared with that pre-treatment in the group A and B ($P<0.0001$) (Table 2).

Between groups comparison: When the mean difference in post-intervention pain range, LSA, and hip extension ROM between the two groups was evaluated, the PNF technique outperformed the MET technique ($P<0.0001$), showing significant difference between both and PNF > MET (Table 2) [19].

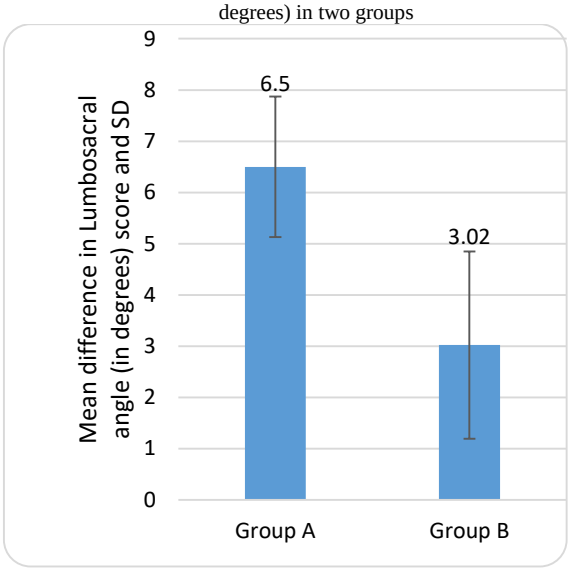
Table 2: Mean NPRS value, LSA angle and right and left hip extension range of motion pre and post treatment of groups A and B and between group A and B

Outcome measures	Group A		P value	Group B		P value	Mean difference (**X±SD**)		P value
	Pre-treatment	**Post-treatment**		**Pre-treatment**	**Post-treatment**		**Group A**	**Group B**	
NPRS	6.20±1.39	2.14±1.19	0.0001	6.14±1.39	4.16±1.14	0.0001	4.06±0.73	1.98±0.79	0.0001
LSA (degrees)	46.86±2.95	40.36±2.03	0.0001	46.92±3.22	43.90±2.54	0.0001	6.50±1.37	3.02±1.83	0.0001
Right Hip ROM (degrees)	14.84±2.53	25.06±3.61	0.0001	14.84±2.91	20.14±2.66	0.0001	10.22±1.90	5.30±1.03	0.0001
Left hip ROM (degrees)	10.56±2.50	21.24±2.49	0.0001	12.68±2.69	17.98±2.55	0.0001	10.68±1.77	5.30±1.03	0.0001

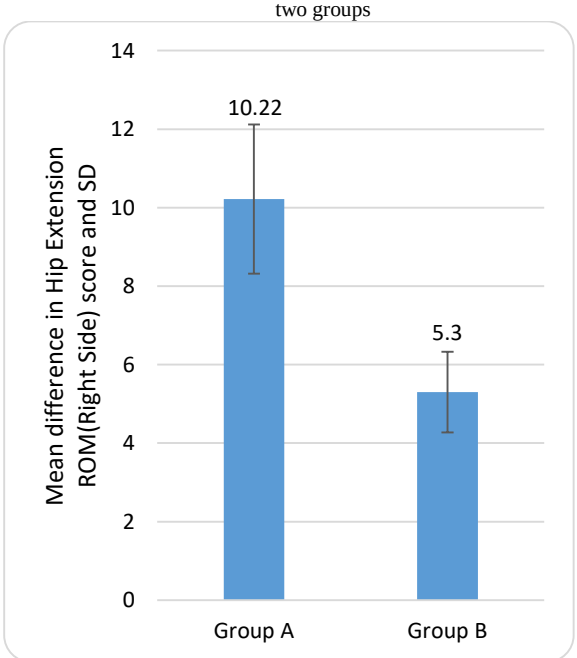
Graph 1: Comparison of mean difference in NPRS score in two groups



Graph 2: Comparison of mean difference in Lumbosacral angle (in degrees) in two groups



Graph 3: Comparison of mean difference in right Hip Extension ROM in two groups



Graph 4: Comparison of mean difference in left Hip Extension ROM in two groups

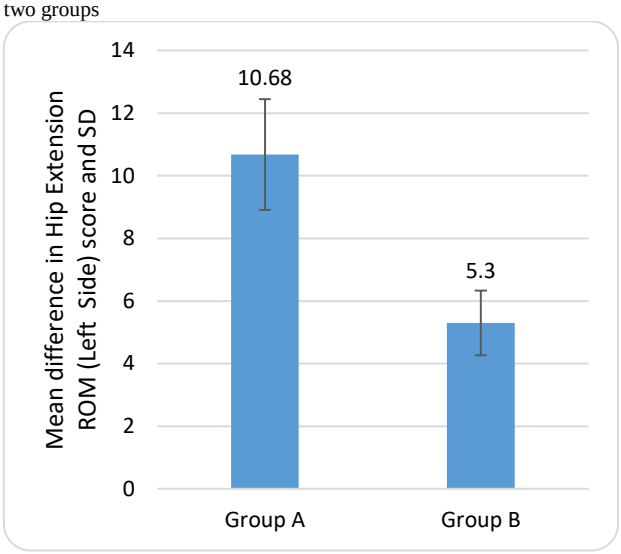


Figure 4: Lumbar lordosis angle before (left) and after (right) PNF stretching

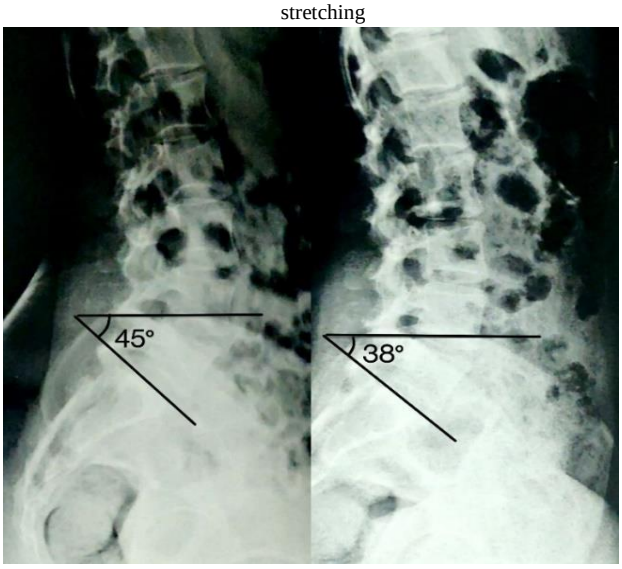
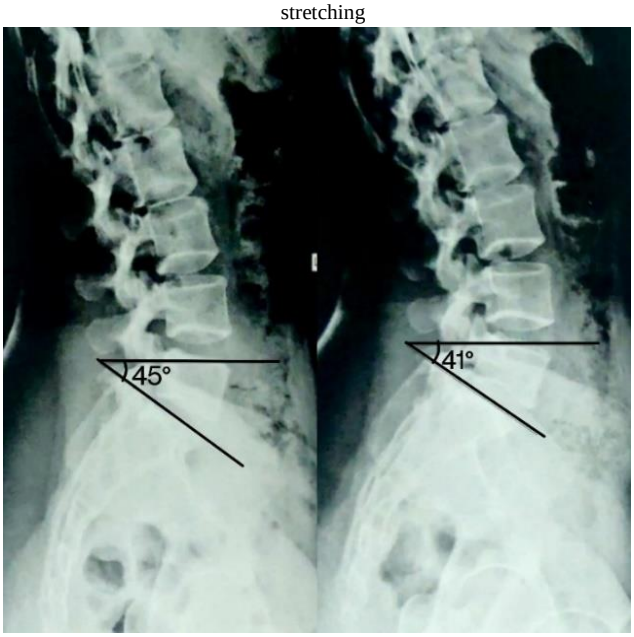


Figure 5: Lumbar lordosis angle before (left) and after (right) MET stretching



DISCUSSION

LBP is one key factor deteriorating the quality of life among the young as well as the elderly population. LBP being a persistent and severe illness, is expected to be addressed as soon as possible, which necessitates adequate examination and treatment planning. One of the most popular reasons for LBP is iliopsoas tightness, which results in lumbar hyper-lordosis and hence LBP. This research assessed the efficacy of PNF with MET stretching for iliopsoas muscle for reducing low back pain in individuals with lumbar hyper-lordosis. Jun-yong Lee's study found a substantial difference in iliopsoas muscle tension between the low back pain patient group and the control group, and he proposed that greater attention should be made to releasing iliopsoas muscle tension during physiotherapy sessions. In another study the flexibility of iliopsoas was improved in supine, knees semiflexion and lateral posture as a direct result from this muscle's stretching, it also led to retroversion and neutralization of pelvis.

The result of this study showed significant improvement in outcome measures in both PNF and MET group but more significant result was seen in PNF group. This can be corelated with Marvin's discovery where PNF hold-relax group experienced considerable improvements in range, which he thought would be described by connective tissue's active mobilization and autogenic inhibition. Suthichan Malai also discovered in her research for the immediate impact of hold-relax stretching of the iliopsoas that it reduced angle of lumbar lordosis and pain, improved activation of transversus abdominis, and improved length of hip flexor in patients having non-specific chronic LBP with lumbar hyper-lordosis.

PNF stretching techniques improve joint ROM by utilising voluntary contraction of muscles and encouraging their relaxation to eliminate reflexive contractions of the muscle. It is now commonly utilised as a stretching therapy to improve flexibility, these include hold-relax, contract-relax, slow reversal etc. They all require sequential contractions and relaxations of antagonist and agonist muscles. For best results, three repetitions of active push phase of 10-second followed by a passive rest phase of 10-second should be performed. PNF stretching should, in theory, be superior to static stretching techniques since they stimulate not just muscle fibres but also sensory receptors in both the antagonist and agonist muscle.

The MET group also showed improvement in pain, LSA and hip extension ROM. METs are a series of generally painless mobilisation procedures for regaining mobility, reducing muscular spasm, reducing tissue oedema, stretching fibrous tissue, and retraining the inter-segmentally related muscles' stabilising role. It has been used before and found successful in treating musculoskeletal conditions in low back as well as other regions of the body but it still lacks enough evidence for it being effective in regular practice.

The efficacy of both interventions was assessed using three outcome measures namely, NPRS, Lumbar Lordosis Angle (or LSA) and Hip Extension ROM bilaterally. A study found out that a shift of 2-point on NPRS used for LBP indicates a clinically significant shift that goes beyond the measurement error margins. Lumbar lordosis angle measurement was done through lumbosacral angle measurement which has been considered as a gold standard method for the same. For analysing the tightness of the iliopsoas, ROM of bilateral hip extension was used by means of a goniometer which have been validated so that they may be used in clinics with confidence for longitudinal exam.

In this study, PNF and MET stretching are given thrice in a single session. Both the group showed significant improvement in all the three outcome measures. Intergroup comparison showed that PNF group had grown dramatically over the MET group in reduction of lumbar lordosis angle, LBP and increment in hip extension ROM. ($P<0.05$), it had a faster rate of influence and a greater individuals achieved iliopsoas muscle flexibility and reduced their lumbar lordosis angle than MET.

The reasons for PNF to be more effective as compared to MET could be because it involves better positioning and recruitment of the muscle that is intended to be stretched.

Future scope for the study is that it can also be done by involving equal number of male and female patients, it can also be done for any other muscle in the body that occasionally goes for tightness and the study can be done for

a longer period of time to obtain an exact time frame of therapy to treat the tightness using either technique.

Limitations of the study were that only young healthy individuals were included in the study, broad age group was considered for study population and unequal proportions of male and females were recruited.

CONCLUSION

This study concluded that PNF stretching technique is better than the MET stretching technique for the iliopsoas muscle and is also more reliable for relieving pain and reducing lumbar lordosis within a single session.

Ethical approval and dissemination

Ethical Clearance was obtained from the Institutional Ethical Committee of Datta Meghe Institute of Medical Sciences.

Reference number: DMIMS (DU)/IEC/ 2021/379

Patient consent

Written informed consent from the patient and relative was taken.

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