

Immediate Effects of Single Session Post Isometric Relaxation Muscle Energy Technique Versus Mulligan's Bent Leg Raise Technique on Pain and Hamstring Flexibility in Knee Osteoarthritis Participants: A Randomised Controlled Study



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KEYWORDS : Osteoarthritis, Hamstring Flexibility, MET, BLR, AKE test

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ABSTRACT

Osteoarthritis (OA) affects 33–46% of Indian adult with the consequence of pain, reduced function and restriction in daily activities. In this study, single session of post isometric relaxation muscle energy technique (PIR-MET), Mulligan's bent leg raise technique (BLR) and MH alone were compared on pain and hamstring flexibility in knee OA. 90 participants were selected and randomly allocated into three groups (PIR-MET+MH; BLR+MH and MH alone, n=30 in each group). Visual analog scale and active knee extension test (AKE) were recorded at baseline and immediately after interventions. PIR-MET and BLR group were significantly effective ($p<0.05$) in reducing pain and improving hamstring flexibility whereas the MH group did not ($p>0.05$). BLR group was more effective compare to PIR-MET and MH alone. In conclusion, a single session of PIR-MET and BLR technique were capable of reducing pain and improving hamstring flexibility in knee OA.

INTRODUCTION:

Osteoarthritis (OA) is one of the major public health problem which causes functional impairment that reduces quality of life (QOL) worldwide as reported by World Health Organization.¹ According to 2012 data, the prevalence rate of OA in both rural and urban India was ranging from 33% to 46 % of older adult population where female were more affected than men.² The OA is a chronic joint degenerative disease which mainly affect the weight bearing joints specially the lower limb joints.

The pathophysiological changes in OA varies as the condition progress affecting joint articular cartilage as well as soft tissue around the joint.^{3,4} Apart from known articular source of pain in OA knee, tightness of hamstring muscle is one of the non-articular source of pain. Tightness of hamstring muscles if not corrected it is likely to develop flexion contracture of knee in later stage of the disease.⁵ Previous studies reported that an increase in hamstring muscle activation with knee OA was seen while performing the activities of daily living. Normal knee joint load distribution may be altered due to over activation of hamstring muscle and contribution in disease progression in knee OA. Normalizing altered hamstring muscle over activation would be as important as strengthening the quadriceps muscle in preventing the disease progression.^{6,7}

The Mulligan's bent leg raise (BLR) technique is a method of stretching which is painless in nature. It consist of gentle stretching of hamstring muscles performed in a specific direction progressively towards hip flexion. It has been used as a method to achieve greater range of active knee extension (AKE) or straight leg raise (SLR) by increasing flexibility of hamstring muscles. This technique was designed to restore altered activation of hamstring muscles.⁸ On other hand, the muscle energy technique is a manual medicine soft tissue procedure that incorporate precisely directed and controlled, patient initiated-voluntary contraction of muscles (isometric or isotonic contractions) at varying levels of intensity against a distinctly executed counterforce applied by therapist. MET are classified as active techniques in which the patient contributes corrective force designed to improve musculoskeletal function and reduce pain.^{9,10}

There are variety of interventions on literature supporting pain control in knee OA^{11,12} but interventions emphasizing on im-

proving hamstring flexibility in knee OA are limited and yet to be documented. The effectiveness of PIR-MET^{13,14} and BLR technique^{15,16} has been well documented in other conditions. However, comparison between two methods have not yet been documented in knee OA participants. So, effort of this study was to investigate and to compare the effectiveness of single session PIR-MET versus BLR technique along with MH and MH alone in reducing pain and improving hamstring flexibility in knee OA participants. We hypothesized that the single session intervention would be capable of reducing pain and improve hamstring flexibility in knee OA participants.

METHODOLOGY:

In this single intervention assessor blinded randomized controlled study, participants were recruited through advertisement with pamphlet in a local newspaper. There were 162 respondents to advertisement who were interested to participate in the study. Participants were screened with thorough physical examination and 90 participants who fulfilled the selection criteria were recruited to volunteer in this study. Using a computer generated randomization method 90 eligible participants were randomly assigned into three groups (PIR-MET+MH: n=30; BLR+MH: n=30 and MH: n=30). The included participants were of age above 40 years, both gender, radiographic evidence of grade I or II in Kellgren and Lawrence criteria for knee OA¹⁷, bilateral (but tested only severe side) or unilateral involvement, ambulate independently with or without assistive devices, ascend and descend at least a flight of stairs and those who were willing to volunteer in this study. The participants were excluded if they had low back pain, sciatica, history of recent lower limb or spinal surgeries, pathologies or deformities related to spine, knee or hip joints, any neurological disorders, other musculoskeletal problems associated with the knee joint. The study obtained prior approval from the Institutional Ethical Committee. All participants provided their demographic details (Table 1) after signing the informed consent form before collecting baseline data.

The baseline pre-intervention outcome measures consisted of pain assessment using visual analog scale (VAS) and knee joint goniometry in active knee extension test (AKE) to assess the flexibility of hamstring muscles. VAS is a self-completed unidimensional single-item measure of pain intensity in the last 24 hours. The response options of the pain intensity were adhere to

score “0” represent “no pain” and the score “10” represent “worst imaginable pain”. The higher the score of VAS indicates greater pain intensity and the lower the score indicates lesser pain intensity.¹⁸ AKE test is an objective test for measuring tightness of hamstring muscles with goniometer while active knee extension and record knee flexion range of motion.^{19,20} AKE test has shown excellent inter-rater and intra-rater reliability for assessing hamstring flexibility in healthy adults.²⁰

Prior to application of PIR-MET and BLR, participants were made to lie in prone position to receive moist heat to hamstring muscle for 20 minutes.²¹ Soon after the moist heat, the first group received PIR-MET for hamstrings detailed by Leon Chaitow.¹⁰ In a single session PIR-MET, the participants performed isometric contractions using 20% of their strength, 5 second hold with 5 seconds rest time in between each contraction.^{10,13,14} The second group received BLR technique detailed by Mulligan. During BLR technique participants performed isometric contraction of hamstring muscle for progressively five greater position of hip flexion, three pain-free repetitions with 5 second hold.^{8,15} Both outcome measures were recorded by a single therapist who was blinded about group allocation. The outcome measures were recorded at baseline prior to and immediately after a single session interventions on the same day.

Table 1: Demographic details with baseline and post intervention scores

Variables	PIR-MET+MH [^] (N=30)	BLR+MH [^] (N=30)	MH [^] (N=30)	P-value*
Demographic Detail				
Age (Year)	57.90±9.95	58.80±9.93	58.56±9.09	0.932
Height (centimetre)	162.58±9.33	162.72±9.08	163.37±7.33	0.932
Weight (kilogram)	69.36±11.20	69.86±11.34	75.03±10.01	0.088
Body mass index	26.50±4.46	26.61±4.31	28.23±3.48	0.193
Duration (months)	5.80±4.29	5.76±4.18	5.40±4.17	0.920
Male/ Female	19/11	18/12	20/10	NA
Joint (P/ TF/B)	6/21/3	6/21/3	8/18/4	
Baseline Scores				
VAS	6.40±0.93	6.76±1.04	6.70±1.05	0.331
ROM@	54.96±6.26	55.06±5.97	55.03±6.30	0.998
Post Intervention Scores				
VAS	4.50±1.22	4.13±0.97	6.40±1.24	0.000**
ROM@	45.33±6.87	41.86±6.24	54.63±5.88	
[^] Mean & Standard deviation; P=Patellofemoral; TF=Tibiofemoral; B=Both joint; N=number; One-Way ANOVA (* no significant difference = p>0.05);**Large effect size (Eta squared >0.138); @Degree				

STATISTICAL ANALYSIS:

All data were analysed with SPSS version 16 for windows. Mean and standard deviation were calculated using descriptive analysis. The data normality test (always present) were verified by Kolmogorov-Smirnov test. The inter group comparison of baseline and post intervention data were performed using one way ANOVA. The intra group comparison of VAS and ROM scores were done using pair t-test to determine the differences due to interventions. Post hoc Tukey test was performed further to determine the post intervention inter group difference in VAS and ROM scores. For all analysis significance level was set at p=0.05 (95%). Eta Squared and Cohen’s d were used to determine the clinical meaningful changes due to PIR-MET, BLR and MH.

RESULTS:

The demographic details at baseline were analysed and found to be homogenous (age, height, weight, BMI, gender) with p>0.05 (Table 1). Pre-intervention inter group comparison of VAS and ROM score among the groups revealed no significant differences (p>0.05) in VAS (p=0.331) and ROM (p=0.998) (Table 1). Intra group comparison using paired t-test shows significant difference (p<0.05) in VAS and ROM score of PIR-MET and BLR groups (p=0.000) a (.) whereas the MH group did not show significant differences in VAS (p=0.119) and ROM (p=0.090) (Table 2) (Figure 1, 2). Post-intervention inter group comparison of VAS and ROM score among groups shows significant difference (p<0.05) in VAS and ROM (p=0.000) (Table 1). Further, Post hoc analysis were used for multiple comparison which shows greater significant improvement (p<0.05) in BLR group with large effect size (d>0.8) compared to PIR-MET and MH group in VAS and ROM scores. Comparison between PIR-MET and BLR groups shows no significant difference (p>0.05) however, BLR groups shows greater improvements compared to the PIR-MET groups in VAS and ROM scores with medium effect size (Table 3). Comparison of MH group with PIR-MET and BLR group shows significant difference (p<0.05) in VAS and ROM (p=0.000) with large effect size (Table 3).

Table 2: Intra group comparison

PIR-MET	Pre Treatment [^]	Post Treatment [^]	P value	Effect Size
VAS	6.40±0.93	4.50±1.22	0.000*	1.75
ROM@	54.96±6.26	45.33±6.87		1.46
BLR				
VAS	6.76±1.04	4.13±0.97	0.000*	2.61
ROM@	55.06±5.97	41.86±6.24		2.05
MH				
VAS	6.70±1.05	6.40±1.24	0.119**	0.26
ROM@	55.03±6.30	54.63±5.88	0.090**	0.06
[^] Mean & Standard deviation; @Degree; Pair t-test (* significant difference = p<0.05; ** no significant difference); Effect size (Cohen’s d) = Small – 0.2, Medium – 0.5, Large – >0.8				

Table 3: Multiple Comparison of PIR-MET, BLR and MH Groups

Outcome Measure	Group [^]		Effect size*	Group [^]		Effect size**	Group [^]		Effect size**
	PIR-MET	BLR		PIR-MET	MH		BLR	MH	
VAS	4.5±1.22	4.1±0.97	0.36	4.5±1.22	6.4±1.24	-1.57	4.1±0.97	6.4±1.24	-2.10
ROM@	45.3±6.87	41.8±6.24	0.54	45.3±6.87	54.6±5.88	-1.47	41.8±6.24	54.6±5.88	-2.14

[^] Mean & standard deviation; Post hoc (Tukey) test (*no significant difference = p>0.05; ** significant difference = p<0.05); Effect size (Cohen's d) = Small - 0.2, Medium - 0.5, Large - >0.8; @Degree

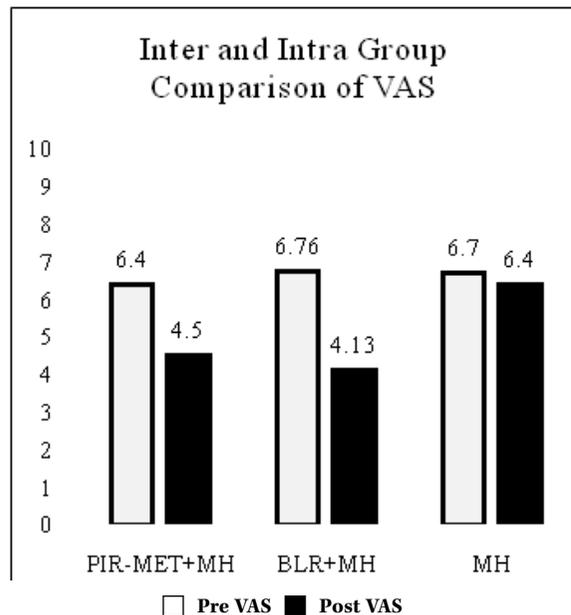


Figure 1: Comparison of VAS scores of PIR-MET; BLR technique & MH group

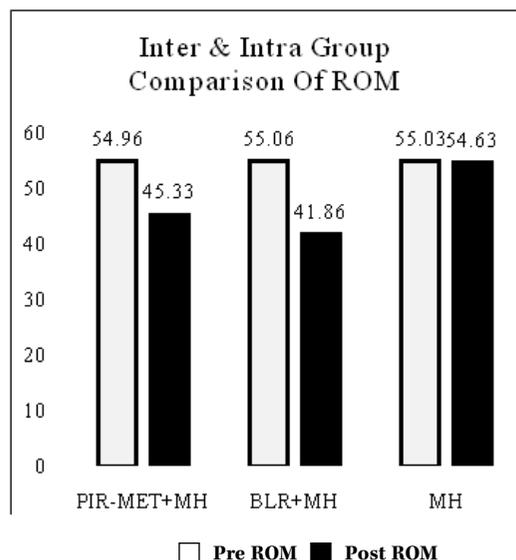


Figure 2: Comparison of knee ROM scores of PIR-MET; BLR technique & MH group

DISCUSSION:

The study provided a controlled evaluation of a single session of PIR-MET and Mulligan's BLR technique on its effects to pain and hamstring flexibility in knee OA participants. The finding shows that a single session PIR-MET intervention as well as BLR leads

to significant improvement in pain as well as hamstring flexibility compared to control intervention (MH alone). However, it was found that BLR resulted in statistically significant and clinically greater improvement compared to PIR-MET and control intervention.

The study included a group of knee OA individuals average aged 58.42±9.56 years, predominance of male 63.33% (PIR-MET group-63.33%; BLR group-60%; MH group-66.66%) with height of 162.89±8.53 cm, weight of 71.42±11.05 kg and BMI 27.11±4.14 kg/m² represents the characteristic of individuals likely to be affected with knee OA. It was also found that the tibiofemoral joint was often affected (PIR-MET group - 63.33%; BLR group - 70% and MH group - 60%) following with the patello-femoral joint (PIR-MET group - 16.66%; BLR group - 20% and MH group - 26.66%) and involvement of both the joint (PIR-MET group - 20%; BLR group - 10% and MH group - 13.33%) respectively.

VAS scores of PIR-MET and BLR group were positively change from baseline scores to post intervention scores which was not seen in MH group. PIR-MET group shows 1.9cm decrement in pain intensity which was in accordance with previous study observed after 6 weeks intervention.²² BLR group show 2.63cm decreased in pain intensity whereas the MH group (control) shows only 0.3cm which was not clinically significant importance. The positive reduction in VAS scores of PIR-MET and BLR shows that both the single interventions were capable of reducing pain related to knee OA. But, it would require a complete treatment approach to determine any beneficial effect of PIR-MET and BLR technique that might contribute on pain.

The study observed significantly increased hamstring flexibility in AKE test following PIR-MET and BLR technique, but not in the MH group. The PIR-MET groups shows 9.63 degree reduction in knee flexion ROM which was in accordance with an earlier study which provided MET for 6 weeks.²² BLR technique group demonstrated 13.2 degree reduction in knee flexion ROM which had similar previous finding.¹⁶ Reduction in knee flexion ROM in MH group was not clinically significant importance. A few literature available on the single session of MET were also found to have contradictory results to our findings. A previous study on healthy asymptomatic participants with hamstring tightness claimed that application of single session MET procedure did not show biomechanical changes in hamstring muscle apart from creating stretch tolerance.²³ Another study on healthy young women treated with 10 sessions MET show similar effect with traditional stretching on restoring hamstring flexibility.²⁴ This study did not observe any significant effect of moist heat alone on pain or hamstring flexibility but it may have complementary positive effects of PIR-MET and BLR technique.²¹

MET involving isometric contraction of muscles stimulate the proprioceptors of muscle fibres which might produce pain relief via pain gate control theory. Immediately following an isometric contraction, a muscle in hypertonic state could be lengthen passively to a new resting length.^{9,10} This theory might explain how there were changes in pain and hamstring flexibility after

PIR-MET. Mulligan's BLR technique involves hip flexion results in caudal loading of lumbosacral nerve roots and sciatic nerve in the pelvis which has unloaded cranially during hip extension.^{25,26} Flexion of hip joint during BLR lead to lumbar flexion and further open the intervertebral foramina and the central canal which facilitates the neural structure to move caudally.²⁷⁻²⁹ Such neural structure movements could diffuse intraneural oedema thereby restoring the pressure gradients and relieving neural hypoxia.³⁰ This improvement in neural mechanics would be probably the mechanism of improvement in pain after BLR techniques.³¹ Decrease in knee flexion in AKE test may be due to temporary change in viscoelastic property³² of hamstring muscles as a result of PIR-MET or BLR technique.

As there are limited literature on similar interventional study design, we cannot comment on whether our findings are in accordance to previous studies or not, but restricted on the immediate effectiveness of the interventions used in the study. One of the major limitations of the study was that short term and long term effectiveness of following changes on pain and hamstring flexibility after the single interventions have not been investigated. Before generalizing these results, further studies can be conducted with long term follow-ups and multiple treatment sessions. As these interventions could not stand alone interventions in the management of knee OA, it can be combined with other known effective interventions to investigate the additive effects. The positive findings of this study may be useful for clinicians while planning short term goal in the management of knee OA.

CONCLUSION:

The results of this study show that a single session of Post Isometric Relaxation Muscle Energy Technique as well as Mulligan's Bent Leg Raise Technique along with moist heat are effective in reducing pain and improving hamstring flexibility in knee osteoarthritis participants. It was evident that the Mulligan's Bent Leg Raise technique along with moist heat was the most effective compared to Post Isometric Relaxation Muscle Energy Technique with moist heat or moist heat alone in reducing pain and improving hamstring flexibility in knee osteoarthritis participants.

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