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ORIGINAL ARTICLE

EFFECTIVENESS OF MUSCLE ENERGY TECHNIQUE ON RECTUS FEMORIS MUSCLE TO REDUCE PAIN AND FUNCTIONAL DISABILITY IN PATIENTS WITH LOW BACK PAIN

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ABSTRACT

Background and objectives: Low back pain is a highly disabling medical condition characterized by pain and discomfort localized to area between the costal margin and inferior gluteal folds, with or without leg pain. The present study aims to investigate the effectiveness of muscle energy technique on rectus femoris muscle to reduce pain and functional disability in patients with low back pain. **Methods:** 30 subjects those fulfilling the inclusion criteria were recruited for the study. Subjects were then allocated to two groups- Group A (Control group) and Group B (Experimental group). Subjects in group A received William's Flexion exercises and subjects in group B received experimental treatment of muscle energy technique on rectus femoris and William's flexion exercises. Pain and functional disability were measured using Numeric Pain Rating Scale and Oswestry Disability Index before and after the intervention period respectively. **Results:** the post test scores of NPRS and ODI of control and experimental group were analysed using two sample t test and paired t test. The data analysed showed statistically significant difference in the post test scores of NPRS and ODI of experimental group over control group at 5% significance level. **Conclusion:** The study concluded that muscle energy technique on rectus femoris is effective in reducing pain and functional disability in patients with low back pain.

Keywords: Low Back Pain; Rectus Femoris; Williams Flexion Exercise; Muscle Energy Technique; Oswestry Disability Index

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INTRODUCTION

Low back pain is the most prevalent orthopedic problem treated in the healthcare. It is a common cause for hospital visits and absenteeism[1]. It is considered as a highly disabling medical condition characterized by pain and discomfort localized to area between the costal margin and inferior gluteal folds, with or without leg pain[2]. Based on the duration of symptoms, LBP is classified as acute (six weeks or shorter), subacute (six weeks to three months) and chronic low back pain (three months or longer)[3].

The lifetime prevalence of low back pain around the world ranges between 50% - 84%. The occurrence of low back pain in Indian population is approximately 60% 2. Men and women are equally affected by low back pain at some point of their life. 50% of adults and 30% of adolescents seemed to be affected at least once in their lifetime, in which rising incidence of LBP among young adults are alarming[4]. The workplace demands are attributed to this increased incidence[4]. It is also considered as leading cause of disability. Disability indicates inability to do an activity in a particular manner considered normal for a human being[5]. It leads to detrimental impairments with routine functioning, daily activities and interpersonal relationships[6].

Previous studies reported that high BMI, positive family history, lifestyle etc. strongly predicts incidence of LBP4. Several anatomical structures like intervertebral discs, facet joints, bony structures, muscles, ligaments and fascia can act as potential structures for triggering low back pain[7]. Also, any posture that strengthen lumbar lordosis is considered as one of the main causes of LBP. Anterior tilt of pelvis contributes to lumbar lordosis[8]. Anterior pelvic tilt is a postural deformation caused by the faulty posture which tightens the hip flexors and pull the pelvis downwards creating an excessive lumbar lordosis in spine and causes LBP[9,10]. The force couple which produces anterior pelvic tilt include iliopsoas, rectus femoris, multifidus, erector spinae and quadratus lumborum[11,12]. But the dominance of two joint hip flexor rectus femoris over iliopsoas may cause faulty hip mechanics[13]. Since rectus femoris is a multi-articular postural muscle, it is prone to become tight when overloaded[14]. Studies verified that sedentary behaviour decreases hip extension flexibility and encourages hip flexor tightness[15,16,17]. A study stated that sedentary behaviour of young population greater than or equal to 8 hours are likely to have tight hip flexors[18,19].

A recent study focused on the prevalence of quadriceps tightness in low back pain among females showed that overworking quadriceps muscle can pull the innominate bone and tilt the whole pelvis downward or forward causing anterior pelvic tilt[20]. Another study attributed that quadriceps tightness may cause increased lumbar lordosis, which creates force on posterior articular joints and mechanical stress on discs, connective tissues and muscles and gradually leads to pain[21].

Since LBP is not a disease or disease entity, it needs a thorough evaluation and examination for a better prognosis. X ray imaging and magnetic resonance imaging in nonspecific LBP is not at all useful in diagnosis. Most of the cases are treated based on the clinical course, functional disability and chronicity of the symptoms[22]. The therapeutic approaches for back pain include trunk muscle strengthening and endurance exercise, soft tissue mobilization, Neural tissue mobilization, McKenzie method of mechanical diagnosis and therapy, Williams exercises, Pilates, Spinal manipulation, and traction are found to be effective in treating LBP[23].

The present study focused on the role of rectus femoris in eliciting low back pain and functional disability in young adults and how it can be eliminated using muscle energy technique of rectus femoris. Muscle energy technique is a manual therapy in which patient produces an

isometric contraction in a controlled position and direction against a force applied by a manual therapist. It is found to be effective in acute and chronic low back pain[24].

Rationale of the study: Several studies reported that tight rectus femoris can cause LBP, however there is paucity regarding an effective intervention. Evan Thomas hypothesized that Muscle energy technique is effective in treating chronic and acute low back pain. But results showing the effectiveness of MET on rectus femoris tightness and associated low back pain is still lacking. The present study is to evaluate the effectiveness of muscle energy technique on rectus femoris to improve pain and function in LBP patients.

Objectives:

1. To find out the effectiveness of muscle energy technique on rectus femoris to reduce pain in patients with low back pain.
2. To find out the effectiveness of muscle energy technique on rectus femoris to reduce functional disability in patients with low back pain

METHODOLOGY

This is a Quasi-experimental study, pretest-posttest design with control group. The study setting done at outpatient physiotherapy department of Caritas Hospital, Kottayam, Kerala. Total 30 samples included for the study. Purposive sampling method adapted for collection and allocation of samples two groups.

Inclusion Criteria: Both males and females of age between 25-35 years, Patients having non-specific LBP lasting more than 3 months, Patient having bilateral rectus femoris muscle tightness screened positive by Ely's test, Patients not undergoing any other conventional treatments for pain and routine analgesics.

Exclusion Criteria: Congenital or acquired musculoskeletal or neurological conditions, Abdominal hernia, Recent lower limb injuries, Pregnancy, Recent spinal surgery, Malignancy, Bowel or bladder dysfunction, Patients undergoing sports or fitness training involving trunk muscles, General health problems that prevent the patient from participating in exercise program.

Data Collection: Thirty subjects who fulfil the inclusion criteria were selected and divided into two groups, group A and group B with 15 in each group. Subjects were explained about the intervention and informed consent were obtained from every subjects.

Pre-test was conducted on group A (control) and group B (experimental) by Numeric Pain Rating Scale (NPRS) to measure pain and Oswestry Disability Index (ODI) to measure functional disability.

Group A was given William's flexion exercise 3 sessions of 30 minutes duration per week for a period of 4 weeks. It includes pelvic tilt, single knee to chest motion, double knee to chest motion, partial sit up, hamstring stretch, hip flexor stretch and squat. Each exercise is done with 5-10 seconds hold and will be repeated for 10 times in each session[25,26].

1) Pelvic tilt- The posterior pelvic tilt is performed with the patient in supine lying with their hands at their side and their knees bent. The patient is then instructed to tighten the muscles of their abdomen, and buttock muscles, flattening their back against the couch.

2) The single knee to chest - The patient in supine lying is instructed to bend the knee and hip and wrap their hands around the bent knee to bring the leg toward the chest.

3) Double knee to chest -The patient in supine lying is instructed to bring both the knees towards the chest, with the hands held

together and curls their head forward. While doing the motion, the patient is instructed to keep the knees together and to have the shoulders flat on the couch.

4) Partial sit-up - The partial sit-up exercise is completed with the patient in supine lying with their hands at their sides and their knees bent. The patient is instructed to raise their upper body off the floor, only enough to get their scapula off the couch. The patient is then instructed to gently lower their upper body back to couch in a smooth and relaxed manner.

5) Hamstring stretch - The patient is in supine lying with hands on the side. With one knee bent and other knee straight, the patient is instructed to raise the leg straight towards himself, till he feels the stretch at the back of his thigh. Repeat for the other leg also.

6) Squatting - Stand with two feet shoulder width apart, toes pointed out, grasp hands at chest for balance. Bring hips backward and bend knees to lower down as far as possible with chest lifted.

7) Hip Flexor Stretch - Kneel on one leg and bend the other leg out in front, with that foot flat on the floor. Holding the spine straight, gently push the hips forward until a feel of stretch in the upper thigh of back leg and hip. Repeat with other leg.

Group B were given muscle energy technique on rectus femoris muscle of bilateral limbs for 3 times with 20 % of maximum voluntary isometric contraction for 3 sessions of 10 minutes duration per week for 4 weeks and 30 minutes of conventional therapy.

Patient in prone position with a pillow under the abdomen to prevent anterior pelvic tilt. The physiotherapist stands on the side of table so as to stabilize the patient's pelvis during treatment using cephalad hand. The leg is flexed at hip and knee. The physiotherapist hold leg at ankle and offers resistance to the patient's effort once the restriction barrier has been established. The patient was instructed to do submaximal pain free effort.

The contraction is then followed by taking muscle into new barrier, by taking heel towards the buttocks with patient effort. The stretch should be held up to 30 seconds repeat this once or twice. Other leg is also subjected to the same method[32].

Post-test was conducted on group A and group B by using the same outcome measures after the 4 weeks of intervention.

Outcome measures were Numeric pain rating scale (NPRS) and Oswestry Disability Index (ODI). Materials Used in the study were Consent form, Ball pen, Couch and Data collection sheet.

RESULTS

Comparison of the Pre and Post NPRS and ODI of the two groups

I .Comparison of the Pre NPRS of the two groups:

Pre NPRS	Number	Mean	S.D	Value of t statistic	d.f	Significance
Group A	15	7.33	0.90	0.863	28	0.395
Group B	15	7	1.20			**Not Significant**

Table 1. Comparison of the Pre NPRS of the two groups

Interpretation: Here the value of t statistic (calculated value) is 0.863 and the corresponding tabled value with significance level 0.05(5 percent) and degrees of freedom 28 are 2.04. That is the calculated value is less than the tabled value. This means that the Pre NPRS are not significant at 5% level. There is no significant difference between the pre NPRS of the two groups at 5% level of significance.

II Comparison of the Pre ODI of the two groups

Pre ODI	Number	Mean	S.D	Value of t statistic	d.f	Significance
Group A	15	64.13	9.23	0.994	28	0.329
Group B	15	60.93	8.38			**Not Significant**

Table 2. Comparison of the Pre ODI of the two groups

Interpretation: Here the value of t statistic (calculated value) is 0.994 and the corresponding tabled value with significance level 0.05(5 percent) and degrees of freedom 28 are 2.04. That is the calculated value is less than the tabled value. This means that the Pre ODI values are not significant at 5% level. There is, there is no significant difference between the pre ODI values of the two groups at 5% level of significance.

Comparison of the Post NPRS Values of the two groups

Post NPRS	Number	Mean	S.D	Value of t statistic	d.f	Significance
Group A	15	5.20	0.68	16.933	28	0.000
Group B	15	0.93	0.70			**Significant**

Table 3. Comparison of the Post NPRS Values of the two groups

Interpretation: Here the value of t statistic (calculated value) is 16.933 and the corresponding tabled value with significance level 0.05(5 percent) and degrees of freedom 28 are 2.04. That is the calculated value is greater than the tabled value. This means that the post NPRS Values are significant at 5% level. There is a significant difference between the post NPRS Values of the two groups at 5% level of significance.

Comparison of the Post ODI of the two groups

Post ODI	Number	Mean	S.D	Value of t statistic	d.f	Significance
Group A	15	47.67	6.52	15.501	28	0.000
Group B	15	16.13	4.42			**Significant**

Table 4. Comparison of the Post ODI of the two groups

Interpretation: Here the value of t statistic (calculated value) is 15.501 and the corresponding tabled value with significance level 0.05(5 percent) and degrees of freedom 28 are 2.04. That is the calculated value is greater than the tabled value.

Effectiveness of controlled group (Group A)

Statistical tool used is the paired t test to do Comparison of Pre NPRS-Value and Post NPRS Values

Variable	Mean	N	Std. Deviation	Value of t	d.f	Correlation	Significance
Pre NPRS	7.33	15	0.90	12.911	14	0.705	0.000
Post NPRS	5.20	15	0.68				
Pre NPRS – Post NPRS	2.13		0.64				**Significant**

Table 5. Comparison of Pre NPRS-Value and Post NPRS Values

Interpretation: Here the value of t statistic (calculated value) is 12.911 and the corresponding tabled value with significance level 0.05(5 percent) and degrees of freedom 14 are 2.145. That is the calculated value is greater than the tabled value. This means that the study of pre and post values is significant at 5% level.

The difference between the means of pre NPRS values and post NPRS values are 2.13 and the corresponding standard deviation is 0.64. Here the correlation value between pre NPRS and post NPRS are 0.705. This means that there is a positive correlation between pre NPRS values and post NPRS values.

Comparison of Pre ODI and Post ODI Values

Variable	Mean	N	Std. Deviation	Value of t	d.f	Correlation	Significance
Pre ODI	64.13	15	9.23	10.805	14	0.772	0.000 **Significant**
Post ODI	47.67	15	6.52				
Pre ODI – Post ODI	16.47	15	5.90				

Table 6. Comparison of Pre ODI and Post ODI Values

Interpretation: Here the value of t statistic (calculated value) is 10.805 and the corresponding tabled value with significance level 0.05(5 percent) and degrees of freedom 14 are 2.145. That is the calculated value is greater than the tabled value.

This means that the study of pre and post values is significant at 5% level. That is, there is a significant difference between the pre ODI value and post ODI value of the controlled group at 5% level of significance. Also the P-value for the t test is 0.000, which is less than 0.05.

The difference between the means of pre ODI value and post ODI value are 16.47 and the corresponding standard deviation is 5.90. Here the correlation value between pre ODI value and post ODI value are 0.772. This means that there is a positive correlation between pre ODI value and post ODI value.

Effectiveness of Experimental group (Group B)
Comparison of Pre NPRS Value and Post NPRS Values

Variable	Mean	N	Std. Deviation	Value of t	d.f	Correlation	Significance
Pre NPRS	7	15	1.20	26.588	14	0.679	0.000 **Significant**
Post NPRS	0.93	15	0.70				
Pre NPRS – Post NPRS	6.07	15	0.88				

Table 7. Comparison of Pre NPRS-Value and Post NPRS Values

Interpretation: Here the value of t statistic (calculated value) is 26.588 and the corresponding tabled value with significance level 0.05(5 percent) and degrees of freedom 14 are 2.145. That is the calculated value is greater than the tabled value. This means that the study of pre and post values is significant at 5% level. That is, there is a significant difference between the pre NPRS values and post NPRS values of the experimental group. That is, the post NPRS values are less than the pre NPRS values

The difference between the means of pre NPRS values and post NPRS values are 6.07 and the corresponding standard deviation is 0.88. Here the correlation value between pre NPRS and post NPRS are 0.679. This means that there is a positive correlation between pre NPRS values and post NPRS values.

Comparison of Pre ODI and Post ODI Values

Variable	Mean	N	Std. Deviation	Value of t	d.f	Correlation	Significance
Pre ODI	60.93	15	8.38	29.257	14	0.737	0.000 **Significant**
Post ODI	16.13	15	4.42				
Pre ODI – Post ODI	44.80	15	5.93				

Table 8. Comparison of Pre ODI and Post ODI Values

Interpretation: Here the value of t statistic (calculated value) is 29.257 and the corresponding tabled value with significance level 0.05(5 percent) and degrees of freedom 14 are 2.145. That is the calculated value is greater than the tabled value. This means that the study of pre and post values is significant at 5% level

There is a significant difference between the pre ODI value and post ODI value of the experimental group. That is, the post ODI value is less than the pre ODI Score. The difference between the means of pre ODI value and post ODI value are 44.80 and the corresponding standard deviation is 5.93. Here the correlation value between pre ODI value and post ODI value are 0.737. This means that there is a positive correlation between pre ODI value and post ODI value.

Descriptive Statistics

Age		Frequency	Percentage
Group A	**20-30**	10	66.66
	30-40	5	33.33
	Total	15	100
Group B	**20-30**	10	66.66
	30-40	5	33.33
	Total	15	100

Table 9: Frequency Distribution of age of two groups

Group	Gender	Frequency	Percentage
Group A	**Male** **Female**	**6** **9**	**40** **60**
	Total	**15**	**100**
Group B	**Male** **Female**	**4** **11**	**26.66** **73.33**
	Total	**15**	**100**

Table 10: Frequency Distribution of gender of two groups

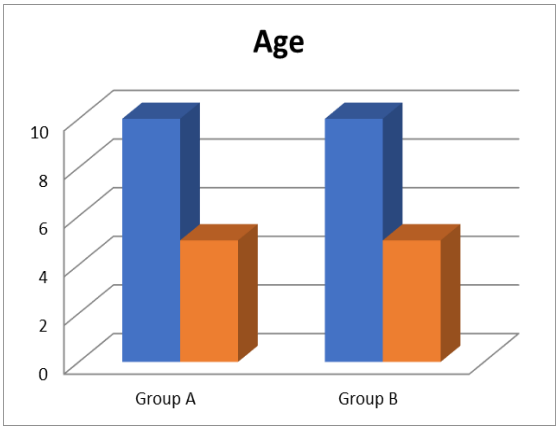
Group		Pre	Post
Group A	**Mean**	7.33	5.20
	N	15	15
	Std. Deviation	0.90	0.68
Group B	**Mean**	7	0.93
	N	15	15
	Std. Deviation	1.20	0.70
Total	**Mean((A+B)/2)**	7.17	3.07
	N	15	15
	Std. Deviation ((A+B)/2	1.05	0.69

Table 11: Frequency Distribution of Pre and Post NPRS of two groups

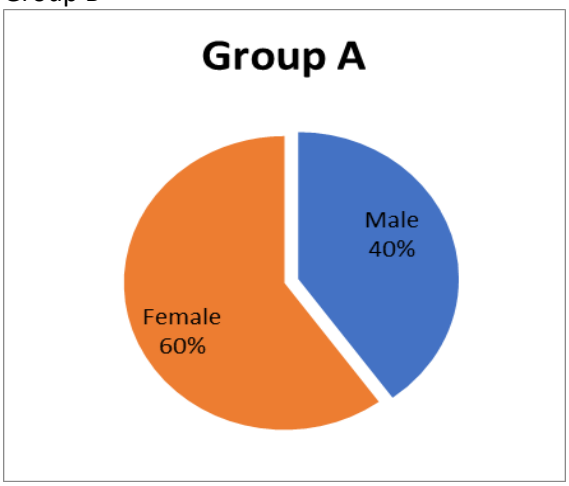
Group		Pre	Post
Group A	**Mean**	64.13	47.67
	N	15	15
	Std. Deviation	9.23	6.52
Group B	**Mean**	60.93	16.13
	N	15	15
	Std. Deviation	8.38	4.42
Total	**Mean((A+B)/2)**	62.53	31.9
	N	15	15
	Std. Deviation ((A+B)/2	8.81	5.47

Table 12: Frequency Distribution of Pre and Post ODI of two groups

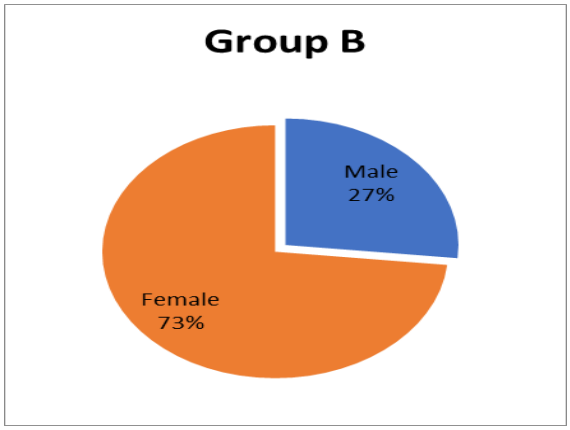
GRAPHS



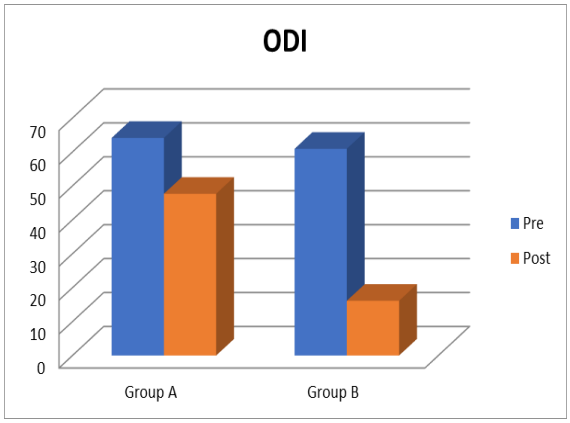
Graph 1: Comparison of Age of Group A and Group B



Graph 2: Comparison of Gender in Group



Graph 3: Comparison of Gender in Group B



Graph 4: Comparison of mean Pre ODI and Post ODI of Group A and Group B

DISCUSSION

This study was conducted to investigate the effectiveness of muscle energy technique on rectus femoris to reduce pain and functional disability in patients with low back pain. 30 subjects those satisfied the inclusion criteria were recruited for the study. Then subjects were allocated to two groups- Group A (control group) and Group B (experimental group), 15 in each group. Subjects in group A received William's flexion exercise and subjects in group B received experimental treatment of muscle energy technique on rectus femoris muscle along with William's flexion exercise.

Pain and functional disability were measured using reliable tools. Pain was measured using Numeric Pain Rating Scale (NPRS) and functional disability was measured using Oswestry Disability Index (ODI). All outcome measures were collected before and after the intervention protocol. In both groups paired t test was used to compare the pre and post-test values. The

post test scores of both groups were analyzed using two sample t test. While comparing group A and group B, the mean of NPRS score of group A was 5.20 and of group B was 0.93. The standard deviation of group A was 0.68 and of group B was 0.70, t value was 16.933 and degree of freedom was 28. The result of the study shows that there is a statistically significant difference between post NPRS values of control and experimental group. The post-test mean of NPRS shows that the experimental group (group B) shows significant reduction in pain than in the control group (group A).

The reduction in pain can be explained in conjunction with the findings of Laithy et al that the isometric contraction is succeeded by the activation of stretch receptors which produce endorphins, endogenous opioids and beta endorphins that modulate pain. Also, the activation of mechanoreceptors give rise to sympatho-excitation evoked by somatic efferents and localized activation of periaqueductal gray matter and induce hypoalgesia[34].

According to Fryer, rhythmic muscle contraction enhances blood and lymph flow rates, and fibroblasts activated by mechanical forces alter the interstitial pressure and transcapillary blood flow. Desensitization of peripheral nociceptors is also achieved by reduced production of pro-inflammatory cytokines as a result of application of MET. The reduction of pain following MET in the present study may probably due to the above-mentioned theories of modulation of pain[29].

While comparing group A and group B, the mean of ODI score of group A was 47.67 and of group B was 16.13, standard deviation of group A was 6.52 and of group B was 4.42, degrees of freedom was 28 and t value was 15.501. The result of the study shows that there is a statistically significant difference between the ODI scores of both experimental and control group at 5% significance level. The post-test mean value of ODI shows that experimental group (Group B) has significant improvement in functional disability in patients with LBP than in the control group (Group A).

The result of the study is consistent with statement of Gary Fryer and Evan Thomas. Fryer stated that application of MET to improve flexibility may potentially induce viscoelastic

and structural change to myofascial tissues. The changes in viscoelastic and plastic properties, alterations in the autonomic mediated change in extracellular fluid dynamics and fibroblast mechano-transduction are attributed to the improved muscle extensibility resulted by MET [30,31,32].

Evan Thomas hypothesized that post-isometric relaxation results in a reduction in muscle tone following an isometric contraction. The resultant increased tension to golgi tendon organ activates type Ib afferent fibres and add an inhibitory input on efferent alpha motor neuron that controls the muscle. Thus, the muscle is relaxed by autogenic inhibition. So, these mechanisms may likely reduce the tightness of rectus femoris and improve the sagittal plane pelvic symmetry thereby relieving the undue stress placed on posterior articular structures and zygapophyseal joints and thus, improving the functional disability supporting the experimental hypothesis[27, 28].

Mills et al commented that restricted hip flexor length can contribute to weakness and reciprocal inhibition of gluteus maximus. Reduced activity of gluteus maximus is a direct biomechanical etiology of low back pain28. According to Janda, reflexively inhibited antagonist often recovers soon after releasing the tightness. So, the rectus femoris extensibility achieved by MET may induce activation of reciprocally inhibited gluteus maximus and count up to the reduction of pain and functional disability[33].

It will be more accurate if the study is conducted with more samples and it is unclear whether there is any quantitative change in pelvic tilt angle and associated lumbar lordosis. Also, the evaluation of electromyographic activity of rectus femoris muscle might provide more evidences regarding the physiological effects of muscle energy techniques.

CONCLUSION

The result of the study showed that the muscle energy technique on rectus femoris along with Williams back exercise is more effective than Williams back exercise alone in reducing pain and functional disability in patients with back pain.

Ethical Clearance: Ethical clearance has obtained from CPAS, School of Medical Education, Gandhinagar, Kottayam, Kerala, Reference number: MPTSA/EC/SME/GNR/2020 /05, Dated: 29/11/2021.

Conflict of interest: There was no conflict of interest to conduct this study.

Fund for the study: It was a self-financed study.

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