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Original Article

Effectiveness of Hamstring Stretching versus Muscle Energy Technique on Hamstring Flexibility in Patients with Non-specific Knee Pain; A Randomized Clinical Trial

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ABSTRACT

Background: The muscle energy technique is one of the best methods to increase range of motion restricted due to muscle spasms and shortening. There is a large number of studies supporting the use of the muscle energy technique for pain and soft tissue mobility but very few studies exist that measure the comparison of this technique with simple stretching. **Objective:** To determine the effectiveness of hamstring stretching versus muscle energy technique on hamstring flexibility in patients with non-specific knee pain. **Methods:** This randomized trial was conducted at Bakhtawar Amin Trust Teaching Hospital, Multan, Pakistan in which patients with non-traumatic knee pain aged from 20 to 50 years were recruited in a study using a non-probability purposive sampling technique. The sample size of this study was 30 which was calculated by expecting a mean pain change of 95% power of study and 5% level of significance. Ethical approval was granted by the Office of Medical Superintendent and from the Department of Physical Therapy of Bakhtawar Amin trust teaching hospital, Multan, Pakistan. Before collecting data, a written consent form in Urdu was signed by every patient recruited. Group A was supposed to receive muscle energy technique while Group B was supposed to receive static stretching. The statistical test employed was an independent sample t-test for baseline and was employed for comparing the post-intervention scores of every variable for the two groups. The between-group difference was calculated using an independent sample t-test while the difference within the groups was calculated using repeated measure ANOVA. **Results:** In this study the effectiveness of METs and hamstring stretching was calculated in patients with knee pain. Out of 30 participants, 16(53.33%) were males and 14(46.66%) were females. The mean and standard deviation of age of muscle energy technique group was 42.47±4.16 and that of hamstring stretching group was 44.48±4.37. The demographic data and scores of all the variables at the baseline of both groups were calculated. **Conclusion:** This study concludes that both the techniques muscle energy technique and stretching both are equally effective in reducing non-specific knee pain and improving the flexibility of hamstring muscles.

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INTRODUCTION

Various musculoskeletal problems affect the population of the world and knee pain is one of them which is observed to compromise the quality of life also. It has been observed to affect both genders but females are more affected by it as compared to males. Callaghan and his co-workers concluded that 3% to 25% of the general population of the United Kingdom has been suffering from anterior knee and patella femoral pain. In the United Kingdom, the overall prevalence of knee pain in females was 25% but in females of age 8 to 35 years, the prevalence was 13%.[1,2] Patients who suffer from pain in the knee and patella femoral region often present with lessened flexibility of muscles of lower extremities such as calf and hamstring muscles as compared to other healthy people.[3,4] The knee joint is the joint that is most affected by damage whether chronic or acute.[5] The higher rate of incidence of injuries of the knees is major because of conformation occurring anatomically which is dependent on dynamic stabilizers and since the knee joint is a joint that is most subjected to consistent overloading.[6] One of the most possible etiologic factors which are recognized to generate the overloading on the knee joint is the unilateral dysfunction of the sacroiliac joint.[7]

When the sacroiliac joint is hypomobile it is due to bad posture, imbalances of the muscles and abnormality in the neuromuscular control. This has been recognized to make the knee joint not have its natural and proper arthrokinematics thus making the turning movement inefficient and then leading towards the overloading of the joints.[8,9] The hamstring muscle is composed of two parts anatomically, the long head and the short head.[10,11] The hamstring has a biomechanically significant function in the complex movement of the hip, pelvis and spine. The dysfunction of the hamstring muscles might occur because of a sedentary lifestyle or surgical interventions.[12] Knee flexion and pelvic posterior tilt have been observed to shorten the length of the hamstrings, which results in tender points and muscle tension in the hamstrings. In addition to this, inflexibility and shortened hamstrings might also cause poor posture, pain in the lower back and other walking abnormalities.[13] Generally, massage, cold/thermal therapy, stretching, electrotherapy, neurodynamic treatments, myofascial release, muscle energy techniques and proprioceptive neuromuscular facilitation have been used to improve muscle flexibility.[14-16]

Non-specific knee pain is defined as knee pain that is not endorsed to any recognizable and specific known pathology, such as a tumor, infection, fracture, osteoporosis and any inflammatory process.[17] In patients who have shortened and tightened hamstrings, stretching exercises have been observed to result in an increased range of motion and no alteration in muscle stiffness.[18] A large number of clinicians and health care professionals are supporting this practice based on the theory, that the natural length of the hamstring prevents the excessive flexion of the lumbar spine during postures that are observed to place the hamstrings in a lengthened position such as forward bending.[19,20] McGill and co-workers concluded in their study that an increased flexion of the lumbar spine during tasks that require forward bending increases the shearing forces on the spine anteriorly and thus increases the risk of injuries. Thus if a decrease in the flexibility of the hamstring is present it will lead to an increased lumbar flexion during forward bending tasks and it might also increase the risk of injury to the spine if the mechanical stress is increased.[21,22] Among the interventions which are used to treat non-specific knee pain muscle energy technique, which is a technique that has been observed to use the principles of

neurophysiology to relax the overactive muscles and lengthen the shortened muscles.[9,23] This technique is a method in which the patient actively uses his or her muscles from a controlled position in a specified direction against a force opposing its motion, resulting in restoring joint mobility. This has been based on, after a pre-stretching contraction of the retracted muscle, this will relax resulting in autogenic inhibition and it would be easily lengthened and elongated, hence increasing the joint mobility.[24,25]

Muscle energy techniques (METs) have been indicated to those patients who have symptoms of a painful musculoskeletal system that presents tightened muscles and abnormal activity of joints.[26,27] The METs has been ranked among the most active structural techniques, in which the patient actively participates by applying muscle strength and then dosing the technique.[26] The patient is then instructed to contract the agonist muscle isometrically against the resistance of the physical therapist.[9] Then this contraction is sustained for three seconds for the neurophysiological inhibitory effect to occur on the muscle spindle.[28] Numerous researchers have suggested various ways of applying METs by making alterations in the force, the period of contractions, the directions of applying contractions and the length of post contraction and the stretch applied after contraction.[29] A large number of studies have evaluated and investigated different treatments for improving flexibility and joint range of motion. These studies have concluded that stretching and muscle energy techniques are both effective for improving the flexibility of joints nevertheless there is still some assumption and conjecture about which is the most effective intervention to be used by physical therapists.[30] Since both the interventions, stretching and METs be effective in improving hamstring flexibility, conducting studies on comparing these two would add more to the knowledge of the physical therapists. Knowing which one is more effective and efficient or if both have similar efficacy would save the physical therapist's time in choosing from these two. This current study would be helpful in covering the conjecture regarding that which intervention is more effective. And if both have similar effectiveness both the techniques might be used as a conjunct for treating the non- specific knee symptoms.

METHODS

This current study is a randomized clinical trial that was conducted at the outpatient department of physical therapy, Bakhtawar Amin Trust Teaching Hospital, Multan, Pakistan. Patients with non-traumatic knee pain aged from 20 to 50 years were recruited in this study.[18] Non-probability purposive sampling technique was used to recruit them into this study. The sample size of this study was 30, which was calculated by expecting a mean pain change of 95% power of the study and a 5% level of significance.[31] Thirty patients were recruited in this study. Before commencing the study, precise and proper ethical approval was granted by the Office of Medical Superintendent and from the Department of Physical Therapy of Bakhtawar Amin trust teaching hospital. Before collecting data, a written consent form in Urdu was signed by every patient recruited in this study. The inclusion criteria of this study were that the patient must have non-specific traumatic knee pain as a major complaint which should not be prevailing for less than two weeks. Using the active knee extension (AKE) test, the patients should also present with a deficit of twenty degrees of knee extension. The tightness of the hamstring muscles was considered during the AKE test. In the patient in supine, the femur held at ninety degrees of hip flexion and loss of AKE of more than twenty degrees was considered as tightness of the hamstring. Those patients

were excluded from this study who were already undergoing physical therapy treatment or taking any other kind of medication or suffering from any other systematic disease. Patients suffering from any other meniscus or ligament impairment were also excluded from this study. Various physical therapy screening tests were performed such as anterior and posterior drawer test, valgus and varus test, bounce home test, Thessaly test and McMurray's test.

Group A had received METs while Group B received static stretching. After taking into account the considered inclusion and exclusion criteria, the potential patients were considered. Every patient was requested to draw one card from the box. The card with number one was allotted to Group A while number two was allotted to Group B. The patient's first follow-up consisted of a complete and thorough case history, complete physical examination and regional assessment of the knee. The patient also had to completely answer the numeric pain rating scale and lower extremity functional scale and perform an active straight leg raise and anterior knee extension test. Along with this range of motion of the knee was measured using a universal goniometer. For Group B, the stretching group, 3 stretches were given per session and each stretch lasted to thirty seconds.[32] In group A, the hamstring muscle was taken into a position that was just short of pain or the one in which the first resistance was felt by the physical therapist during treatment. Then the physical therapist applied the resistance while the patient applied the sub-maximal contraction almost 20% of muscles were involved for 20 seconds.

After this, the patient was asked to relax, while doing relaxation the muscle was taken into a new position till the new barrier was reached, again METs were used. A total of three METs were applied in each session. On the follow-up visits, the re-assessments of patients were done and patients were also asked to complete the questionnaires. All thirty patients received a total of four sessions over two weeks which consisted of two sessions of treatments per week. The statistical test employed was an independent sample t-test for baseline and was employed for comparing the post-intervention scores of every variable for the two groups. The statistical significance was set at $p < 0.05$ and the between-group difference was calculated using an independent sample t-test while the difference within the groups was calculated using a repeated measure ANOVA test. For the representation of group measurements of descriptive statistics, frequency tables, pie and bar charts were used. Statistical Package of Social Sciences version 23 was employed for all the statistical work.

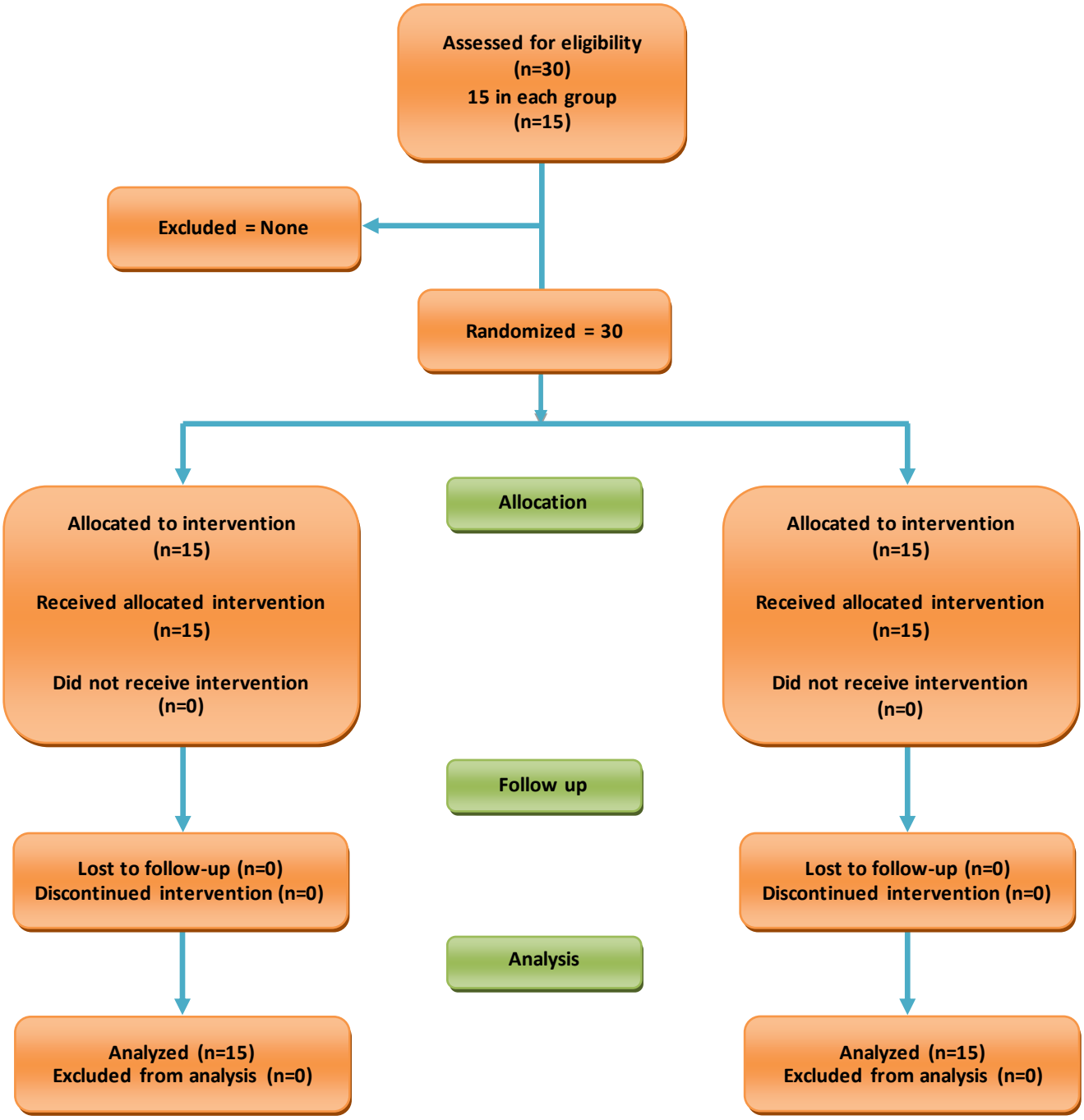
RESULTS

In this study the effectiveness of METs and hamstring stretching was calculated in patients with knee pain. Out of 30 participants, 16(53.33%) were males and 14(46.66%) were females. The mean and standard deviation of age of MET group was 42.47±4.16 and that of hamstring stretching group was 44.48±4.37. The demographic data and scores of all the variables at the baseline of both groups (Table I). The outcome measures for all the variables were presented in Table-II.

DISCUSSION

30 patients were included in this current study after they met the inclusion criteria. Then they were divided into two groups, Group A was the one which received the METS which included patients with the mean age of 44.48±4.37 years, the other group which was treated by stretching and included patients having a mean age of 42.47±4.16 years. Our current showed that there is an immediate and significant improvement in knee pain, functioning of the lower extremity, flexibility

Figure I: Consort Diagram



hamstring muscles, active straight leg raising and anterior knee extension after being treated by muscle energy technique and stretching. The number of published studies comparing the effects of these two interventions is quite low. The effects of various kinds of stretching techniques for lengthening the tightened and shortened muscles give us a vague picture.[33] Very little can be yet concluded regarding the most effective intervention. Therefore this

Table I: Sociodemographic and Descriptive Analysis of Study Subjects (n=30)

Characteristics of Variables	Baseline Mean±SD MET Group (n=15)	Baseline Mean±SD Stretching group (n=15)
Age	44.48 ± 4.37 SD	42.47 ± 4.16 SD
Gender	Female = 9 , Male = 6	Female = 5 , Male = 10
Effected knee	Right = 8 , Left = 7	Right = 9 , Left = 6
NPRS	6.8 ± 1.32 SD	6.7 ± 0.96 SD
AKE (degrees)*	55.67 ± 8.63 SD	55.67 ± 7.98 SD
ASLR (degrees)*	59 ± 8.06 SD	57 ± 7.74 SD
LEFS Score	65.8 ± 0.077 SD	67.33 ± 0.077 SD
Deep Squat ROM (degrees)*	74.33 ± 8.83 SD	74.33 ± 10.49 SD
Deep Squat pain (VAS)*	7.46 ± 1.24 SD	7.6 ± 1.12 SD

Table II: Variables for Lower Extremity Functional Scale, Range of Motion and Pain

Variables	Baseline mean (± SD)	Post-treatment mean (± SD)	Follow Up 1 mean (± SD)	Follow Up 2 mean (± SD)	Follow-Up 3 mean (± SD)
MET group A AKE	55.67 (8.63)	63.66 (9.72)	68.66 (8.12)	73.66 (5.49)	80.33 (4.41)
Stretching group B AKE	55.67 (7.98)	64.00 (8.90)	68.33 (6.17)	74.33 (4.95)	78.33 (4.87)
MET group A NPRS	6.80 (1.32)	5.93 (1.62)	4.80 (1.52)	3.2 (1.57)	2.06 (1.67)
Stretching group B NPRS	6.73 (0.96)	6.20 (0.77)	5.06 (0.88)	3.3 (0.89)	2.20 (1.52)
MET group A LEFS	65.87(0.07)	70.70 (0.07)	75.33 (0.06)	80.87 (0.08)	84.47 (0.09)
Stretching group B LEFS	6733 (0.07)	72.30 (0.08)	76.80 (0.07)	82.07 (0.08)	86.73 (0.11)
MET group A ASLR	59.00 (8.06)	66.00 (8.90)	70.33 (8.75)	76.33 (7.18)	81.66 (3.61)
Stretching group B ASLR	57.00 (7.74)	64.66 (8.12)	69.33 (6.22)	75.33 (4.41)	79.33 (5.30)
MET group A Deep Squat ROM	74.33 (8.83)	80.66 (8.63)	84.66 (8.75)	88.00 (7.74)	95.00 (8.66)
Stretching group B Deep Squat ROM	74.33 (10.49)	80.00 (9.81)	84.33(9.03)	88.66 (8.33)	96.00 (9.48)
MET group A Deep Squat Pain (VAS)	7.46 (1.24)	5.8 (1.37)	4.80 (1.20)	3.60 (1.40)	1.86 (1.35)
Stretching group B Deep Squat Pain (VAS)	7.69(1.12)	5.8 (1.20)	4.60 (1.05)	3.53 (1.18)	1.67 (1.34)

Table III: Basic Group Statistics for Numeric Pain Rating Score for Both Groups

Treatment Group		N	Mean	Std. Deviation	Std. Error Mean
Numeric Rating Pain Scale Reading before 1st Session	MET	15	6.8000	1.32017	.34087
	Stretching	15	6.7333	.96115	.24817
Numeric Rating Pain Scale Reading after 1st Session	MET	15	5.9333	1.62422	.41937
	Stretching	15	6.2000	.77460	.20000
Numeric Rating Pain Scale Reading after 2nd Session	MET	15	4.8000	1.52128	.39279
	Stretching	15	5.0667	.88372	.22817
Numeric Rating Pain Scale	MET	15	3.2667	1.57963	.40786
Reading after 3rd Session	Stretching	15	3.3333	.89974	.23231
Numeric Rating Pain Scale Initial Reading after 4th Session	MET	15	2.0667	1.66762	.43058
	Stretching	15	2.2000	1.52128	.39279

Table IV: Basic Group Statistics for Active Knee Extension Score for Both Groups

Treatment Group		N	Mean	Std. Deviation	Std. Error Mean
Active Knee Extension Test before 1st session	MET	15	55.67	8.633	2.229
	Stretching	15	55.67	7.988	2.063
Active Knee Extension Test after 1st session	MET	15	63.6667	9.72234	2.51030
	Stretching	15	64.0000	8.90425	2.29907
Active Knee Extension Test after 2nd session	MET	15	68.6667	8.12111	2.09686
	Stretching	15	68.3333	6.17213	1.59364
Active Knee Extension Test after 3rd session	MET	15	73.6667	5.49892	1.41981
	Stretching	15	74.3333	4.95215	1.27864
Active Knee Extension Test after 4th session	MET	15	80.3333	4.41858	1.14087
	Stretching	15	78.3333	4.87950	1.25988

Table V: Basic Group Statistics for Lower Extremity Functional Scale Both Groups

Treatment Group		N	Mean	Std. Deviation	Std. Error Mean
Lower Extremity Functional Scale before 1st session	MET	15	.6587	.07736	.01997
	Stretching	15	.6733	.07743	.01999
Lower Extremity Functional Scale after 1st session	MET	15	.7070	.07685	.01984
	Stretching	15	.7230	.08013	.02069
Lower Extremity Functional Scale after 2nd session	MET	15	.7533	.06873	.01775
	Stretching	15	.7680	.07552	.01950
Lower Extremity Functional Scale after 3rd session	MET	15	.8087	.08079	.02086
	Stretching	15	.8207	.08623	.02226
Lower Extremity Functional Scale after 4th session	MET	15	.8447	.09471	.02445
	Stretching	15	.8673	.11081	.02861

technique and stretching. These two have been recognized as commonly used methods in improving hamstring flexibility. An evaluation, assessment and comparison of pre-test and post-test values of the Active knee extension test revealed that there is a significant improvement in both the treatment groups, which demonstrates that both the techniques are equally effective individually. The results of the effects of METs in this current study agree with the research conducted earlier.[34-36] This current study has utilized stretching to produce substantially greater improvements in the range of motion in both groups, showing us that both interventions are equally effective for improving the flexibility of hamstrings. While evaluating the outcome measure in the follow-ups, the scores for hamstring flexibility represented by various tools were higher than that of the pre-test score. This was consistence with the previously conducted studies.[35] Shadmehr and co-workers conducted a study to determine the flexibility of the hamstring in young females after treating them with passive stretching and MET.[31] The The young females were allotted into two groups, one the stretching group (n=15) and the other the MET group (n=15). Their group allocation and sample size coincided with the sample size and group allocation of our study. While their tool to measure the flexibility of the hamstring was a passive knee extension test while the study employed other outcome-measuring tools mentioned in the methodology.

Their results coincided with the results of our study. Their results showed that both methods of treatment were proficient in significantly improving the shortened and tightened hamstring muscles. No significant difference was observed by them between both the interventions ($p<0.01$). Our results were also just the same. They concluded that 10 sessions of hamstring stretches in normal young females using either MET or stretching had similar effects on improving the flexibility of

hamstring muscles.[31] Our study agrees with their conclusion.

Adel Rashad Ahmed conducted a study to compare the efficacy of muscle energy techniques and dynamic stretching in improving the flexibility of hamstring muscles in healthy grownups.[33] Their results also agreed with our results but with a slight divergence. Their results showed that there was a substantial improvement in the flexibility of hamstring muscles after the application of the muscle energy technique and stretching, but the improvement shown by the muscle energy technique was more than that of stretching. So, they concluded that both these interventions improve the flexibility of the hamstring in healthy adults which is in agreement with our study. The limitations of this current study are that a larger sample size is needed to make this study more reliable and generalized considering the Pakistani population. This current study is also limited to only a few outcome measures more outcome measures might also be used for more variety of results. More functional scales could also have been included in this study. Future researchers are recommended to conduct this trial with a larger sample size In Pakistan and more outcome measures to increase the reliability of both these interventions. Future researchers are also recommended to use other forms of stretching also. Future researchers are also recommended to conduct studies on comparing the effects of various forms of stretching for improving the flexibility of hamstrings.

CONCLUSION

This study concludes that both the techniques muscle energy technique and stretching both are equally effective in reducing non-specific knee pain and improving the flexibility of hamstring muscles. No technique has been observed to be superior to another.

DECLARATIONS

Consent to participate: Written consent had been taken from patients. All methods were performed following the relevant guidelines and regulations.
Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.
Competing interests: None
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CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

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