ijlpr 2023; doi 10.22376/ijlpr.2023.13.1.L122-127

International Journal of Life science and Pharma Research

ISSN 2250-0480

Effectiveness of Muscle Energy Technique in Improving Hamstring Flexibility in Patients with Knee Osteoarthritis

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Abstract: Osteoarthritis is one of the main reasons for the disability and socio-economic burden in the world. There is a solid scientific basis for the possibility of decreased hamstring flexibility in patients with knee OA. Shortening the hamstring muscle leads to an increased patellofemoral compressive force, resulting in patellofemoral syndrome often associated with Osteoarthritis. The present study aims to determine the effectiveness of Post isometric relaxation in increasing hamstring flexibility in patients with knee osteoarthritis. 40 patients with pre-diagnosed cases of knee osteoarthritis were included in this study. The patients were divided into two groups, i.e., Group A and Group B. Group A was the experimental group, and Group B was the control group. Group A subjects were subjected to post-isometric relaxation of the hamstring muscle, and Group B subjects were subjected to static stretching of the hamstring muscle for 3 sessions per week for 2 weeks, i.e., a total of 6 sessions. The outcome measure was the Active Knee Extension (AKE)test. The Pre Vs Post-test mean value of AKE was 18.4 ±1.3 in the experimental group, and in the control group was 10.6 ±.48, with p-value < .001**. The result shows greater improvement in the experimental group's AKE compared to the control group. The study concluded that MET (post-isometric relaxation) significantly improves hamstring flexibility in patients with knee osteoarthritis.

Keywords: Knee Osteoarthritis, Active Knee Extension Test, Hamstring Flexibility, Post-Isometric Relaxation, and MET: Muscle Energy Technique

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Received On 29 August, 2022
Revised On 29 October, 2022
Accepted On 8 November, 2022
Published On 2 January, 2023

Funding This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

Citation J Andrews Milton and Dr.S.Subbiah , Effectiveness of Muscle Energy Technique in Improving Hamstring Flexibility in Patients with Knee Osteoarthritis.(2023).Int. J. Life Sci. Pharma Res.13(1), L122-127 http://dx.doi.org/10.22376/ijlpr.2023.13.1.L122-127

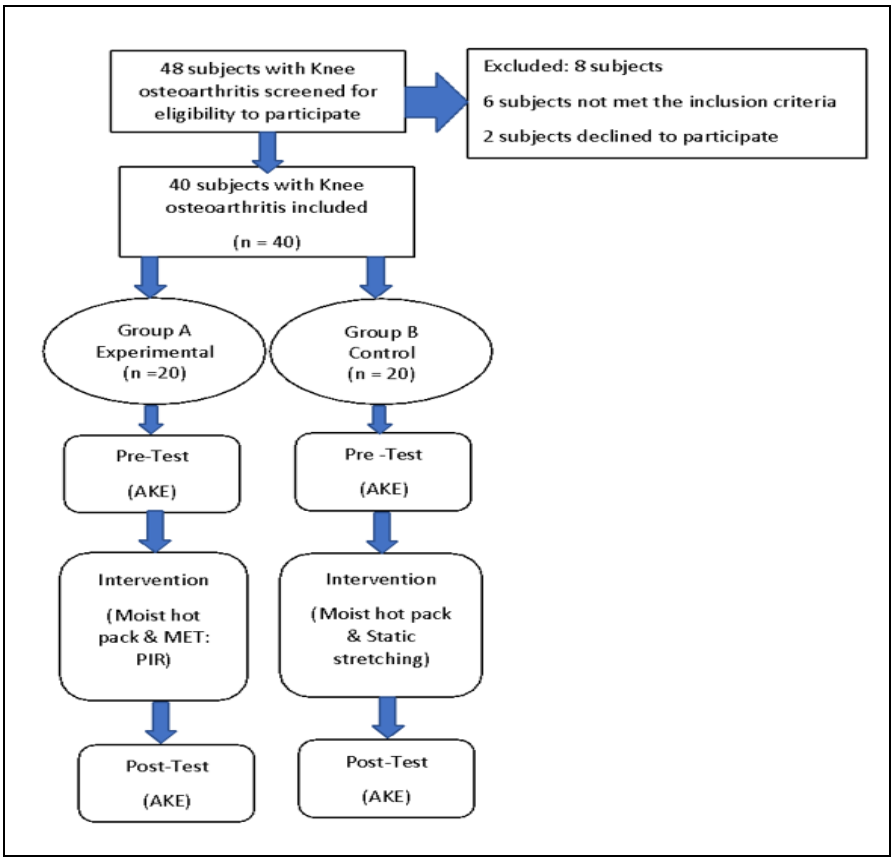
1. INTRODUCTION

According to the American College of Rheumatology, the definition of Osteoarthritis (OA) is a "heterogeneous group of conditions that lead to joint symptoms and signs which are associated with defective integrity of articular cartilage, in addition to related changes in the underlying bone at the joint margins."[1,2] Osteoarthritis is the second most common rheumatological problem and is the most frequent joint disease, with a prevalence of 22% to 39% in India.[3] It is the 4th leading cause of years lived with disability (YLDs), accounting for 3.0% of total global YLDs, as per WHO 2000 estimation.[4] As per the report of the World Health Organization, osteoarthritis of the knee is the 4th most common cause of disability among women, and the 8th among men.[5] OA occurs commonly in females above 45 years of age. [6] Ageing and being overweight are the major reasons for the incidence of OA.[7] Symptomatically, the most commonly affected joint in osteoarthritis is the knee joint because of its weight-bearing requirement, high mobility, and lack of intrinsic stability.[8] Furthermore, in people with knee pain, the most common compartmental distribution of radiographic osteoarthritis was a combination of tibiofemoral joint and patellofemoral joint disease (40%), followed by isolated patellofemoral OA (24%) and isolated tibiofemoral OA (4%).[9] In individuals with knee OA, the joint has limited flexion and extension ROM (Range of motion). This results from pain, damaged articular cartilage, loss of extensibility of the capsule surrounding the joint, and muscles acting over the joint.[10] Loss of flexibility in knee osteoarthritis leads to decreased functional ability. Flexibility is defined as the ability of a muscle to lengthen and allow the joint to move through a full range of motion. The flexibility degree of the hamstring muscle contributes to the accurate and coordinated movement in the knee joint. Hence the individual is predisposed to musculoskeletal dysfunction with inadequate flexibility. [11] The consequences of the shortening of the hamstring muscle are increased patellofemoral compressive force, which results in patellofemoral syndrome often associated with osteoarthritis [12, 13] Hence there is a strong scientific basis for the possibility of decreased hamstring flexibility in patients with knee OA.[11]. Also, quadriceps weakness in knee osteoarthritis contributes to hamstring tightness. Gajdosik and Lusin have recommended the AKE test for measuring hamstring length. The AKE test has high test-retest reliability (.99) when body position is controlled, the endpoint of motion is specifically defined, and the measuring instrument is accurately placed.[14] Muscle energy technique (MET) is a manual therapy in which gentle isometric contractions are used to relax the muscles via autogenic or reciprocal inhibition and lengthen the muscle. The patient also has an active role in this technique. Muscle Energy Techniques are used to lengthen the contracted or spastic muscle, strengthen the weak muscles, and mobilize the joint with a restricted range of motion[15]. Muscle Energy Technique (MET) is an effective treatment strategy for hamstring flexibility. Several studies have explored the effectiveness of MET and Passive stretching in hamstring tightness in normal individuals.[16,17] There is a lack of studies to determine the effectiveness of the muscle energy technique(MET) in improving hamstring flexibility in subjects with knee osteoarthritis. Therefore, the present study aims to evaluate the effectiveness of Post isometric relaxation in increasing hamstring flexibility in patients with knee osteoarthritis.

2. METHODOLOGY

2.1 Consort Flow Diagram

Methodology



2.2 Study Design

Pre-test-post-test experimental design.

2.3 Study Setting

The outpatient department of Bethany Navajeevan College of Physiotherapy, Thiruvananthapuram.

2.4 Study Sample

40 patients with knee osteoarthritis.

2.5 Sampling Design

Simple random sampling.

2.6 Study Duration

6 months.

2.7 Inclusion Criteria

Diagnosed case of knee osteoarthritis, both men and women, age group 40 to 65 years, unilateral knee osteoarthritis, in case of bilateral knee OA dominant side, Kellgren and Lawrence grade ≤3, criteria of American College of Rheumatology for Knee OA, tight hamstring which is indicated by 20 degrees of AKE with the hip in 90 degrees of flexion.

2.8 Exclusion Criteria

Subjects who had knee or lower limb surgery, Fracture & dislocation of the knee, Genu valgus or varus deformity, had received an intra-articular corticosteroid or hyaluronic acid injection within the past 6 months, reported current or past (within 4 weeks) oral corticosteroid use, had inflammatory or neurological disorders, had altered sensation around their knee, cognitive difficulties, systemic illness was excluded from the study.

3. METHODS

48 subjects with knee osteoarthritis diagnosed by an orthopaedic surgeon have been screened for inclusion in this study. 2 subjects declined to participate. 40 subjects met the inclusion criteria, and Informed consent was obtained from them. Ethical clearance was obtained from the institutional ethics committee, Ref. No. BNCP/F/01. All procedures performed in this study followed the ethical standards given in the 1964 Declaration of Helsinki, as revised in 2013. The subjects were divided into two groups, i.e., Group A and Group B. Group A was the experimental group, and Group B was the control group. A pre-test was conducted on the Active Knee Extension (AKE) test for groups A and B.

3.1 The procedure of Active Knee Extension (AKE) Measurement

Fig.1: Active Knee Extension test

The participants were positioned supine without a pillow underneath their heads. The tested extremity was placed at 90 degrees of hip flexion and 90 degrees of knee flexion. The lower leg was kept on a stool, with the contralateral lower extremity placed flat on the table and secured by a strap. Subjects were then instructed to slowly extend their testing side knee until they felt the first stretch sensation, with the foot relaxed. A standard universal goniometer was placed over the previously marked joint axis, and the goniometer arms were aligned along the femur and tibia/fibula. The AKE measurement was defined as the degree of knee flexion from a terminal knee extension. (Fig.1) This process of knee extension was performed three times, and the mean measurement was then used as the basis for inclusion in the study[18]. After a brief demonstration, Group A subjects were subjected to post-isometric relaxation of hamstring muscles.

3.2 The procedure of Post Isometric Relaxation of Hamstring Muscles

The position of the subject was supine lying. The therapist passively flexes the subject's hip until the restriction barrier is felt. From this point, the subject lowers the leg against the therapist's shoulder resistance and holds the for 7-10 seconds. After the of the hamstring, during the relaxation phase, the therapist passively took the leg into the new restriction barrier and held in this new barrier for 30 seconds. During the following 10 seconds rest period, the procedure was repeated. The dosage was 2 repetitions per session, 3 sessions per week for 2 weeks, i.e., 6 sessions[19]. After a brief demonstration, Group B subjects were subjected to static stretching of the hamstring muscle.

3.3 The procedure of Static Stretching of the Hamstring

Subjects in this group were positioned supine on a treatment plinth and instructed to relax as the therapist performed the stretch. The hip was passively flexed to 90^0, the knee passively extended with the ankle 90 degrees, and the subjects were instructed to keep their back as flat as possible. The knee was passively extended until the subject reported a strong but tolerable stretch. The contralateral extremity remained flat on the plinth. The static stretch was maintained for 30 seconds. This sequence was repeated 3 times per session with 10-second rest intervals between each stretch. The dosage was 3 sessions per week for 2 weeks, i.e., 6 sessions[20]. Both groups received a Moist hot pack application for 10 minutes before the start of the intervention. Post tests were conducted on the Active Knee Extension (AKE) test for groups A and B.

4. STATISTICAL ANALYSIS

The results were recorded and analyzed statistically by spss. The difference between pre and posttest values within the group was analyzed by the 'Paired t' test separately in Group A and Group B. The difference in pre vs. posttest values between Group A and Group B was analyzed by 'independent to test.

5. RESULTS

Table 1: Demographic data

Variable		Experimental Group (Group A) (MET: Post Isometric Relaxation)	Control Group (Group B) (Static stretching)
Age(Mean & S.D.)		52.5±3.0	51.8±2.4
BMI(Mean & S.D.)		28.5±1.3	28.6±1.2
Gender	Men	11	8
	Women	9	12

S.D.: Standard Deviation; *BMI: Body Mass Index; *MET: Muscle Energy Technique

Demographic data shows in the experimental group, the mean age was 52.5±3.0, the mean BMI was 28.5±1.3, and Gender distribution was 11(55%) men and 9 (45%) women; in the control group, the mean age was 51.8±2.4, the mean BMI was 28.6±1.2, Gender distribution was 8(40%) men and 12(60%) women.

Table 2: Comparison of Pre and posttest values within Group A and Group B

AKE		Mean & S.D.	N	t value	p-value
experimental group (Group A) (MET: Post Isometric Relaxation)	Pre-test	48.4 ±1.31	20	60.8	< .001**
	Post-test	29.9±1.31			
Control group (Group B) (Static stretching)	Pre-test	48±1.37	20	97.3	< .001**
	Post-test	37.3±1.26			

AKE: Active Knee Extension; * S.D.: Standard Deviation, N: number of samples; *MET: Muscle Energy Technique

Based on the statistical analysis, in the experimental group, the pre-test mean of AKE was 48.4 ±1.31, the posttest mean of AKE was 29.9±1.31, Pre Vs. Post t value was 60.8, and the p-value was < .001**, which shows a statistically significant difference between the pre and posttest values of AKE in the experimental group. On the other hand, in the control group, the pre-test mean of AKE was 48±1.37, and the posttest mean of AKE was 37.3±1.26; Pre Vs. The Post t value was 97.3, and the p value was <. 001**, which shows a statistically significant difference between the pre and posttest values of AKE in the control group.

Table: 3 Comparison of Pre Vs. Posttest values of AKE between Group A and Group B

AKE	Mean & S.D.	N	t value	p-value
The experimental group (Group A) (MET: Post Isometric Relaxation)	18.4 ± 1.3	20	24.193	< .001**
Control group (Group B) (Static stretching)	10.6 ± .48	20		

AKE: Active Knee Extension; * S.D.: Standard Deviation, N: number of samples; *MET: Muscle Energy Technique

While comparing the experimental and control group, The Pre Vs. The posttest means the value of AKE was 18.4 ± 1.3 in the experimental group, and the Pre Vs. The posttest mean value of AKE was 10.6 ± .48 in the control group, the t-value was 24.193, and the p-value was < .001**, which shows a statistically significant difference in AKE between the experimental and control groups group. Also, the result shows a more significant improvement in the experimental group's AKE compared to the control group.

6. DISCUSSION

P. Ratan Khuman, et al. conducted a randomized controlled study. This study aimed to investigate and 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. The 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. The study concluded that Post Isometric Relaxation and Mulligan's Bent Leg Raise Technique and moist heat are effective in reducing pain and improving hamstring flexibility in knee osteoarthritis participants. [21] Ahmed AR conducted a study and concluded that Post isometric relaxation shows greater improvement in hamstring flexibility than dynamic stretching[22] Azizi M et al. conducted a study and concluded that a single session of MET applied for 3 repetitions results in a more tremendous increase in the flexibility and a significant reduction of stiffness in hamstring muscle.[16]. Ramesh et al. conducted as study and found that post isometric relaxation technique is more effective than ultrasound therapy with active static stretching and passive static trying in improving the hamstring flexibility in individuals with hamstring tightness[23]. There is a lack of studies determining the effectiveness of muscle energy technique (PIR) in improving hamstring flexibility in subjects with knee osteoarthritis. Therefore, the purpose of the present study was to determine the effectiveness of Post isometric relaxation in improving hamstring flexibility in subjects with knee osteoarthritis. The result of the study shows that, the experimental group, i.e., the group which was subjected to post-isometric relaxation of hamstring muscle, showed greater flexibility in hamstring muscles than the group which was subjected to static stretching in patients with knee osteoarthritis. The result of the current study supports that of the previous studies. The AKE test has previously been shown to have great intra-tester reliability[14]. A study that compared the AKE with an active SLR and discovered a strong correlation between the two tests' findings also proved the AKE test's convergent validity[18,27]. During isometric contraction, the Golgi tendon reflex is activated resulting in reflex relaxation of the muscle.[22] The resultant muscle relaxation following post isometric relaxation technique can increase the motor activity that increases the vasoactive substances causing vasodilatation.[24] Maintenance of the muscle extensibility is very minimal after static stretching.[25] Static stretching decreases the muscle blood flow because of the longitudinal extension of the blood vessels with muscle stretching and the increase of the intramuscular pressure during stretching. The application of Post isometric relaxation technique produces greater changes in muscle extensibility[26]. Further studies shall be done with a larger sample size.

7. CONCLUSION

From the results, it is found that the pre vs posttest mean value of AKE in the experimental group was 18.4 ± 1.3 and the pre vs post test mean value of AKE in the control group was 10.6 ± .48, the p-value was < .001** which shows that there is a statistically significant difference in AKE between experimental and control group. Thus, the current study demonstrated that Muscle Energy Technique (Post isometric relaxation) significantly improves the hamstring flexibility in patients with knee osteoarthritis.

8. AUTHORS CONTRIBUTION STATEMENT

Mr. J Andrews Milton conceptualized, gathered, and analyzed the data. Dr. S. Subbiah gave valuable inputs towards analyzing the data and designing the manuscript. All authors discussed the methodology and results and contributed to the final manuscript.

9. CONFLICT OF INTEREST

Conflict of interest declared none.

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